Palaeoenvironmental investigation into aspects of the vegetation history of north Fife and south Perthshire, Scotland.

Volume One

Paula Milburn

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Abstract

Results from the palaeoenvironmental investigations into the Holocene vegetation history of three sites in eastern lowland Scotland are presented. Two of the sites, Cruvie and Pitbladdo, are located in north Fife; the third site, Methvern is situated in south Perthshire.

Cruvie is located in a kettle-hole and provides data extending from the Late-glacial to ca. 3900 BP. Pitbladdo is a former bog and cores from this site provide data on the period from ca. 8000 to 3900 BP. Methvern is a well-maintained raised bog and provides data that spans the entire Holocene.

Relative, concentration and pollen preservation data are supplemented by loss-on-ignition, pH and magnetic susceptibility analyses. Microscopic charcoal data are also recorded. Radiocarbon dates allow comparisons to be made between similar events at different sites, resulting in a detailed picture of temporal and spatial patterns of palaeoecological change within a small geographical area.

Attention is focused upon the identification of human impact on the environment during the early to mid Holocene. The influences of succession and climate change in determining patterns of vegetation change are also considered. The data obtained indicate that human activity may have had a limited impact on the environment in this area during the Mesolithic, but no unequivocal evidence is recorded. Anthropogenic impacts are more clearly identified during the Neolithic period and from the late Neolithic/early Bronze Age, human activity is considerable and includes pastoral and mixed farming.

The value of tephra as a dating tool in this area of eastern Scotland is considered. The absence of tephra at the three sites investigated has led to the formulation of a hypothesis linking patterns of orographic rainfall and tephra deposition within Scotland.

The study highlights the difficulties of determining the causal factors of vegetation change and the limitations of palaeoecological data in the identification of anthropogenic activity during the early Holocene. The recognition of climate signals is discussed and the routine counting of microscopic charcoal at all sites is proposed. It is suggested that further research is required to clarify the boundaries of tephra deposition in Britain. Finally the diverse patterns of change recorded within the study area emphasise the need for a network of closely spaced and well dated palaeoenvironmental sites covering the regions of Scotland, leading to the recognition of local patterns of environmental change.

Chapter Plan

Presented in Volume One.

Part One: Aims, background and methods.

Continuation of Chapter Plan

Continuation of Chapter Plan

Part Two: Results and preliminary discussion.

Continuation of Chapter Plan

Part Three: Discussion and conclusions.

Continuation of Chapter Plan

Presented in Volume Two

List of Figures

List of Figures continued

List of Figures continued

List of Tables

List of Tables continued

List of Plates

List of X - radiographs

List of Appendices - Presented in Volume Two.

Appendix One - Processing techniques.

Appendix Two - Data tables.

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Part One: Aims, background and methods.

Chapter One - Introduction.

1:1 - General introduction.

Today's modern landscape predominantly reflects land management by the human population; however, the landscape we see today represents only a single phase in a process of ongoing change. Archaeological remains represent the tangible evidence of past human activity and provide valuable insights into past societies; but the landscapes in which these sites are now found have been subject to long term modification. In order to fully interpret the archaeological evidence it is necessary to place it into its environmental context. The reconstruction of the palaeoenvironmental history of an area allows us to gain insights into the way in which our environment has changed over time and the factors which have instigated these changes.

This study sets out to investigate the patterns of vegetation development within the area of north Fife and south Perthshire, in order to improve our understanding of vegetation development and change, and to assess the extent to which human populations may have modified the environment and the degree to which this be detected in the vegetation record during the early Holocene.

This investigation is based upon the analysis of palynological and sedimentary data recovered from peat deposits within the study area. As peat deposits develop they incorporate and preserve material from the surrounding landscape, creating a continuous record of past environmental conditions. By analysing the information contained within this record it is possible to determine the nature of the surrounding landscape and processes affecting it on a long term basis. Pollen is considered to be one of the most valuable and informative ways of determining patterns of vegetation change and is a well established investigative method (see 1:6 for details). Changes in the representation of different pollen taxa allow us to determine the range and relative abundance of the different plant taxa over time and at a range of spatial scales, whilst changes in the composition of the peat, its degree of decay and the amounts of mineral material within the peat, allow an assessment of changing sedimentary conditions.

The area of north Fife and south Perthshire was chosen for investigation for a number of reasons.

1) The area contained a considerable number of peat deposits in a range of locations, offering considerable potential for the establishment of a network of closely linked sites.

2) Previous work undertaken within this region (see 1:6:1) indicated that the palaeoecological history of this area of Scotland was extremely complex, and that synchronous changes in vegetation could not be assumed across even limited distances. This highlights the need for the investigation and integration of data from a series of sites, if a true picture of vegetation development was to be established within this area.

3) Previous work relating to the recovery and identification of a number of tephra horizons in peat deposits within Scotland and Ireland (see Chapter 3) suggests that this area of eastern Scotland was likely to contain an extensive tephrochronological record, covering the majority of the Holocene. The investigation of palaeoenvironmental sites in the areas of north Fife and southern Perthshire provided the opportunity to apply this developing dating tool in a region in which little research had been undertaken. The use of tephra isochrones can provide a degree of temporal resolution not possible using conventional radiocarbon dating techniques. It was hoped that the identification of tephra horizons in peat deposits in this region would provide the opportunity to develop a three dimensional pattern of vegetation change, based upon a series of precisely dated tephra isochrones.

4) The presence of a high density of archaeological remains dating from a range of periods (see Chapter 3) indicates that this area has been extensively utilised by a human population for the majority of the Holocene. Due to problems of site preservation many palaeoenvironmental sites investigated are located at high altitudes or in areas of limited agricultural potential. Such sites tend to be marginal in relation to human activity and the data they provide is difficult to interpret in relation to possible human activity. The presence of a number of palaeoenvironmental sites within an area of considerable human activity offered the opportunity to investigate the impact of humans on the palaeoenvironment, and allowed an assessment of the extent to which human activity may be detected during the early Holocene.

5) Although this area contains a considerable number of potential palaeoenvironmental sites it is unclear how long these sites will remain within the landscape. The favourable climate and high quality soils of this area of Scotland make it ideally suited to intensive agricultural practices. Due to these practices, many of the palaeoenvironmental sites within this region are being drained as part of 'land improvement' programmes, resulting in site degradation and loss of the environmental record. In addition areas of peat are being lost to afforestation and destroyed during quarrying for sands and gravels. Many of the sites that upon initial inspection appear to retain a full Holocene record are upon analysis found to have been extensively cut (see Chapters 5 and 6), or contain mixed sequences due to the common practice of dumping waste earth (for example ditch material) into boggy areas, that are considered to have little agricultural value (see 1:3:4). It is therefore

considered that any palaeoenvironmental reconstructions for this area of eastern lowland Scotland must be undertaken now, before the record is irretrievably lost.

For these reasons it was considered that this area of Scotland had considerable potential both in terms of the apparent availability of suitable sites for investigation, the complexity of the palaeoenvironmental record within this area, and the opportunity to develop an understanding of vegetation change in an area of considerable importance in relation to human activity. In addition this research was able to investigate palaeoenvironmental sites which may soon cease to exist in this intensively farmed, increasing populated area of lowland Scotland. The overall aim of the research, to assess palaeoenvironmental change in northern Fife and southern Perthshire during the Holocene, incorporated three specific objectives.

1) To establish a clear understanding of the patterns of vegetation development across a small geographical area, allowing an evaluation of the degree of variation occurring within a limited area that shares similar climatic, altitudinal and topographical conditions.

It is becoming increasingly clear as the number of pollen sites investigated increases that the concept of regional patterns of vegetation development may not adequately reflect past events. It is proposed that although general trends may be recognised on a regional scale, local conditions are of primary importance. These variations result in the development of complex and widely divergent vegetation patterns even within small geographic areas. One of the aims of this research was to test this proposal by evaluating the impact of variations in local conditions on patterns of vegetation development within a limited area.

2) To evaluate the intensity, extent and nature of human activity within the area during the Holocene, with particular emphasis placed upon the Mesolithic and Neolithic periods. Attention was focused upon the extent to which human activity could be detected within the palaeoenvironmental record and the project aimed to:

- Determine the nature of this activity in relation to the exploitation and modification of the early Holocene woodland environment.
- Assess the rate and timing of woodland modification and clearance and relate this to possible changes in human landuse.
- Relate the palaeoenvironmental record to the tangible archaeology of the area.

3) To assess the extent to which tephra could be used as an effective dating tool in a lowland area of intensive archaeological activity. In recent years tephra has been successfully identified in a number of areas in the British Isles, providing a new and potentially powerful dating tool. However, the majority of these sites has been located in isolated highland areas, marginal in relation to the main

centres of human activity, thereby limiting the establishment of links between the archaeological and tephrochronological records. By attempting to establish a tephrochronology in an area containing a long and intensive archaeological record, the extent to which tephra could be integrated into a general palaeoenvironmental investigation and its value as a dating tool could be assessed.

In addition to these three specific objectives it was hoped that it would be possible to detect a palaeoclimatic signal within the palaeoenvironmental record, based upon an integration of the pollen, spores and microscopic charcoal data. By assessing the nature of the palaeoclimatic signal at sites displaying a range of hydrological regimes, it was hoped that it would be possible to recognise general trends across the area and to assess local catchment-based responses to change.

These objectives were met through the investigation of a number of palaeoenvironmental sites within the study area. This report is split into three parts, the first of which outlines the background information and methods upon which the rest of the study is based. The remainder of Chapter One (1:2 - 1:5:3) outlines the geographical location and physical characteristics of each of these sites, including a detailed assessment of the local geology and dominant soil types; and a brief consideration of the range of previous palynological work undertaken in the study area (1:6). The criteria by which sites were selected is presented in Chapter 2 (2:1). The methods used during sample collection and analysis, using a range of techniques; the factors likely to influence the preservation and distribution of pollen, and hydrological conditions in lakes are also outlined in Chapter 2 (2:2 - 2:5). Chapter 3 considers the nature of the archaeological evidence and highlights the distribution of archaeological remains in the area surrounding each of the sites investigated. In Chapter 4 the relatively new technique of tephrochronology is discussed, including an assessment of the factors influencing its distribution and deposition across the British Isles.

The second part of this report presents the results and preliminary discussion for each of the three sites investigated. Chapter 5 considers the palaeoenvironmental record from Cruvie, Chapter 6 from Pitbladdo and Chapter 7 from Methvern.

The final part of the report presents a select discussion of a number of key areas of interest and overall conclusions. Part 3 integrates data from all of the sites investigated; topics discussed include climate change (8:1), early Holocene woodland development (8:2) and human activity (8:3).

1:2 - Geographical setting for the study.

In order to address these issues successfully a study area was required containing a range of deposits spanning the Holocene and also containing an extensive archaeological record, covering periods from the Mesolithic to the present day. The area of north Fife and south Perthshire was considered ideal (figures 1 and 2). This area contains a sizeable number of peat deposits in a range of locations, offering considerable potential for the establishment of a network of closely linked sites.

Figure 1 showing the general location of the study area within Scotland.

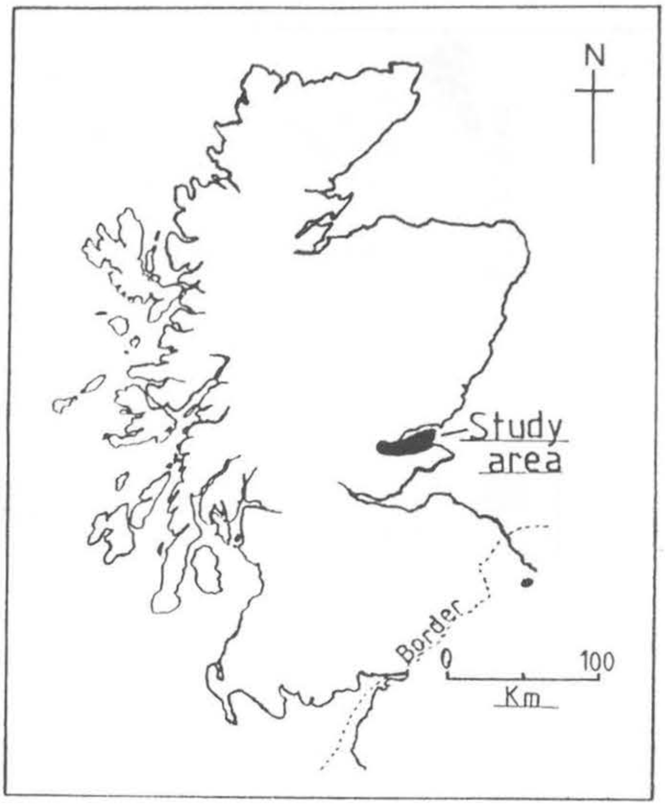


Figure 2 showing the main access routes to the study area.

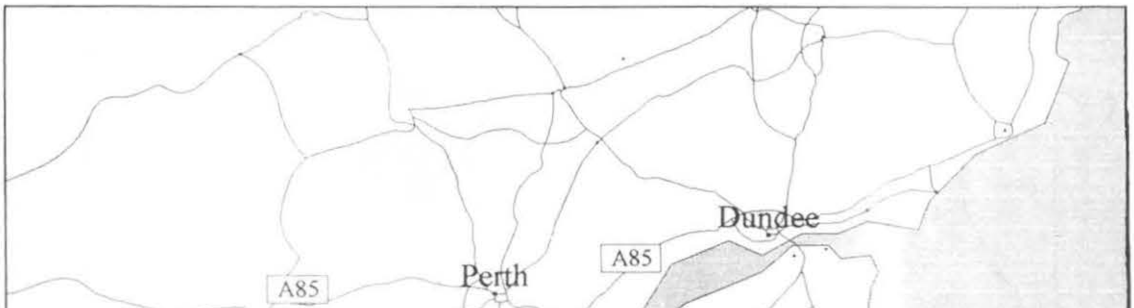


Figure 3 showing the location of the sites under investigation.

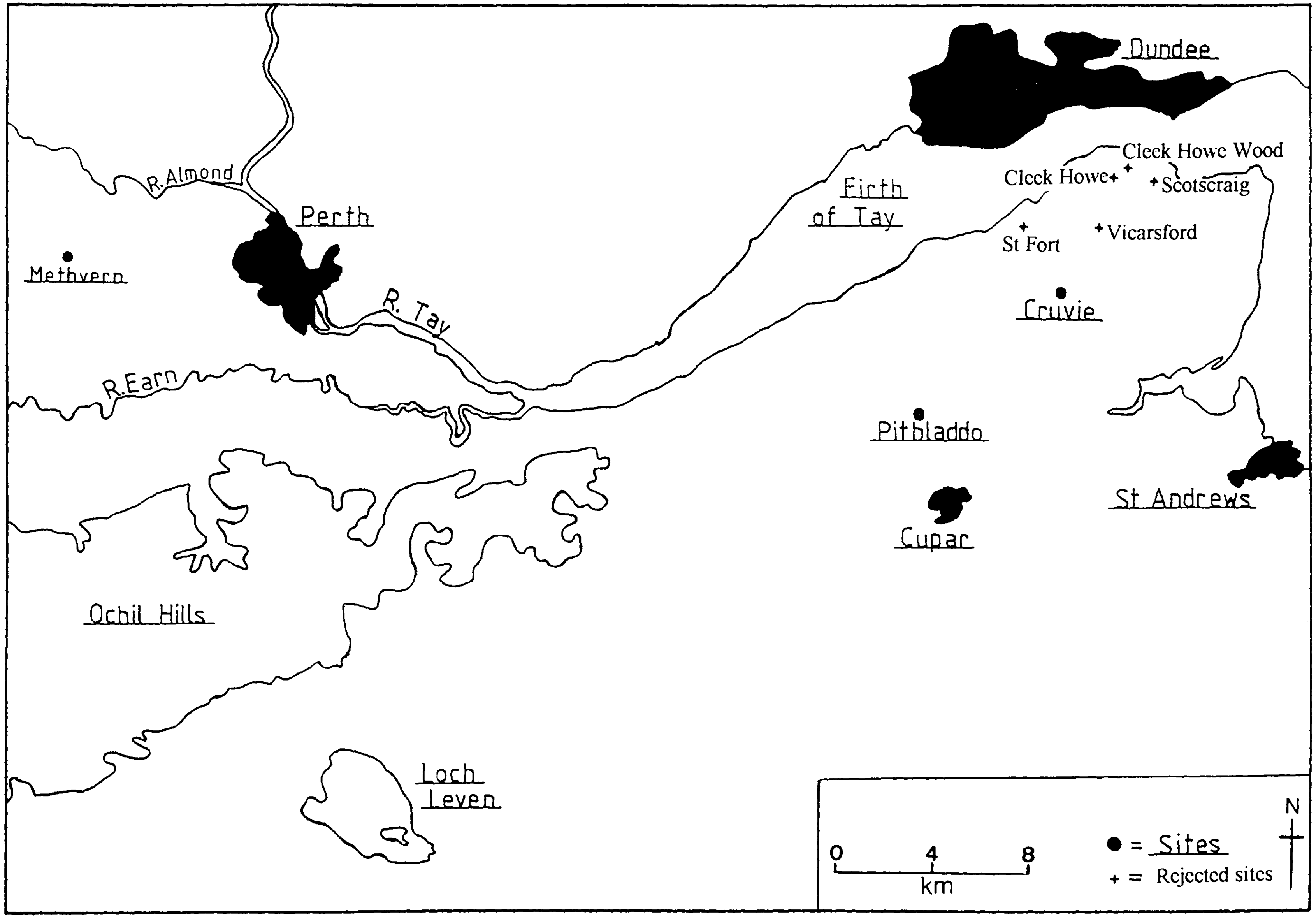


Table 1 showing sites initially investigated.

Site	Location	Altitude	Field work undertaken / results.
Methvern	011237	40m OD	Trial coring across site indicated organic deposits of greater than 6m.
Pitbladdo	361175	67m OD	Trial coring across site indicated organic deposits of greater than 5m.
St Fort	414252	25m OD	Recorded on geological maps but test pits and trial coring failed to locate organic deposits. Site rejected.
Cruvie	418228	48m OD	Trial coring across site indicated organic deposits of greater than 4m.
Vicarsford Cemetery	437256	15m OD	Trial coring across site indicated organic deposits of up to 2m. The presence of a complete Flandrian sequence was considered unlikely and the site was rejected.
Cleek Howe	438281	50m OD	Trial coring across site indicated organic deposits of up to 6m.
Cleek Howe Wood	442284	100m OD	Trial coring across site indicated organic deposits greater than 6m. Consultation with land owner suggested area had been substantially modified. The site was rejected due to likely sediment mixing.
Scotscraig	452278	18m OD	Site located beneath modern valley fill during archaeological investigation at Scotscraig. Coring indicated organic deposits of 3m in depth. The presence of a complete Flandrian sequence was considered unlikely and the site was rejected.

By carefully examining potential sites it was possible to select ones that shared general characteristics (climate, altitude), whilst at the same time showed a degree of variation (geology, soils, topography and hydrology), allowing the impact of localised conditions to be assessed. The archaeological record from this area indicates human activity in all periods from the Mesolithic onwards, making it an ideal area in which to undertake an evaluation of both the impact of humans upon their past environment, and a comparison of the palaeoenvironmental and archaeological records.

Several potential sites were identified within the study area (based upon the criteria outlined in chapter 2:1). Figure 3 and table 1 show the location of these sites and the findings of the preliminary fieldwork. Following the initial field assessments four sites were considered to be suitable for further investigation. Three of the sites, Cruvie, Pitbladdo and Cleck Howe, were located in northern Fife and the fourth site, Methvern, was located in southern Perthshire (figure 3). The sites shared similar lowland locations within the same climatic zone, with a mean monthly temperature of 13^{0}C, an average of 30 inches of rainfall per year and a growing season of around 240 days per annum (Laing 1976), but were subject to different local conditions. Sections 1:3, 1:4 and 1:5 detail the physical characteristics of each of the sites.

1:3 - Site Locations

1:3:1 - Cruvie.

The site at Cruvie (NOGR 418 228), is located on the floor of a closed basin (figure 4) in a former kettle-hole, at a height of 48 m OD, approximately 9 km north-east of Cupar and 6 km south-east of Dundee (figure 3). The site occupies an area of approximately 88 m by 50 m, the majority of which is currently occupied by a lake and is separated from the surrounding arable land by a margin of planted trees (plates 1, 2 and 3).

An initial assessment of the site by Dr R. Tipping in 1989 (pers. com.) revealed peat deposits of greater than four metres in depth, suggesting the presence of a sedimentary record spanning the majority of the Holocene period. On the basis of these favourable findings a full palaeoenvironmental investigation of the Cruvie site was undertaken.

Trial coring undertaken around the perimeter of the lake and the edge of the surrounding arable land indicated that the deepest and best preserved deposits were located in the south-east corner of the lake area and it is from this location that cores were extracted (figure 4).

1:3:2 - Pitbladdo.

The site at Pitbladdo (NOGR 361 175) is located on the floor of a gently sloping valley at a height of 67 m OD, (figure 5, plates 4 and 5), approximately 3 km north-west of Cupar and 12.5 km south of Dundee (figure 3). The site occupies an area of approximately 1125 m by 200 m

Figure 4 showing the location of the site at Cruvie and the area from which samples were extracted.

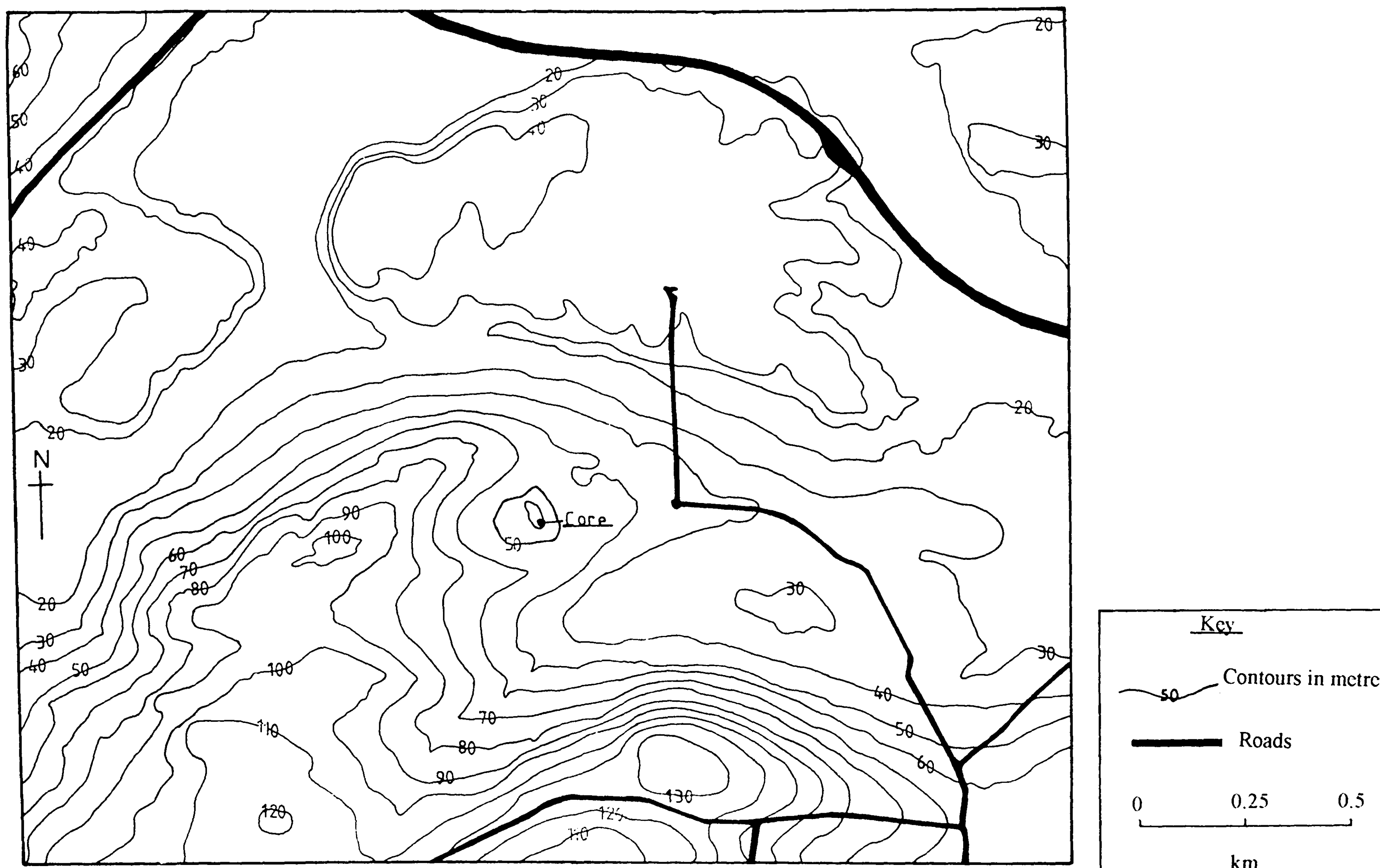


Plate 1 - Looking north towards Cruvie. The coring site was located on the southern edge of the present lake which is bordered by planted trees.

Plate 2 - The view from the coring site at Cruvie looking south across the present day lake.

Plate 3 - The view from the coring site at Cruvie looking west across the present day lake.

Figure 5 showing the location of the site at Pitbladdo and the area from which samples were extracted.

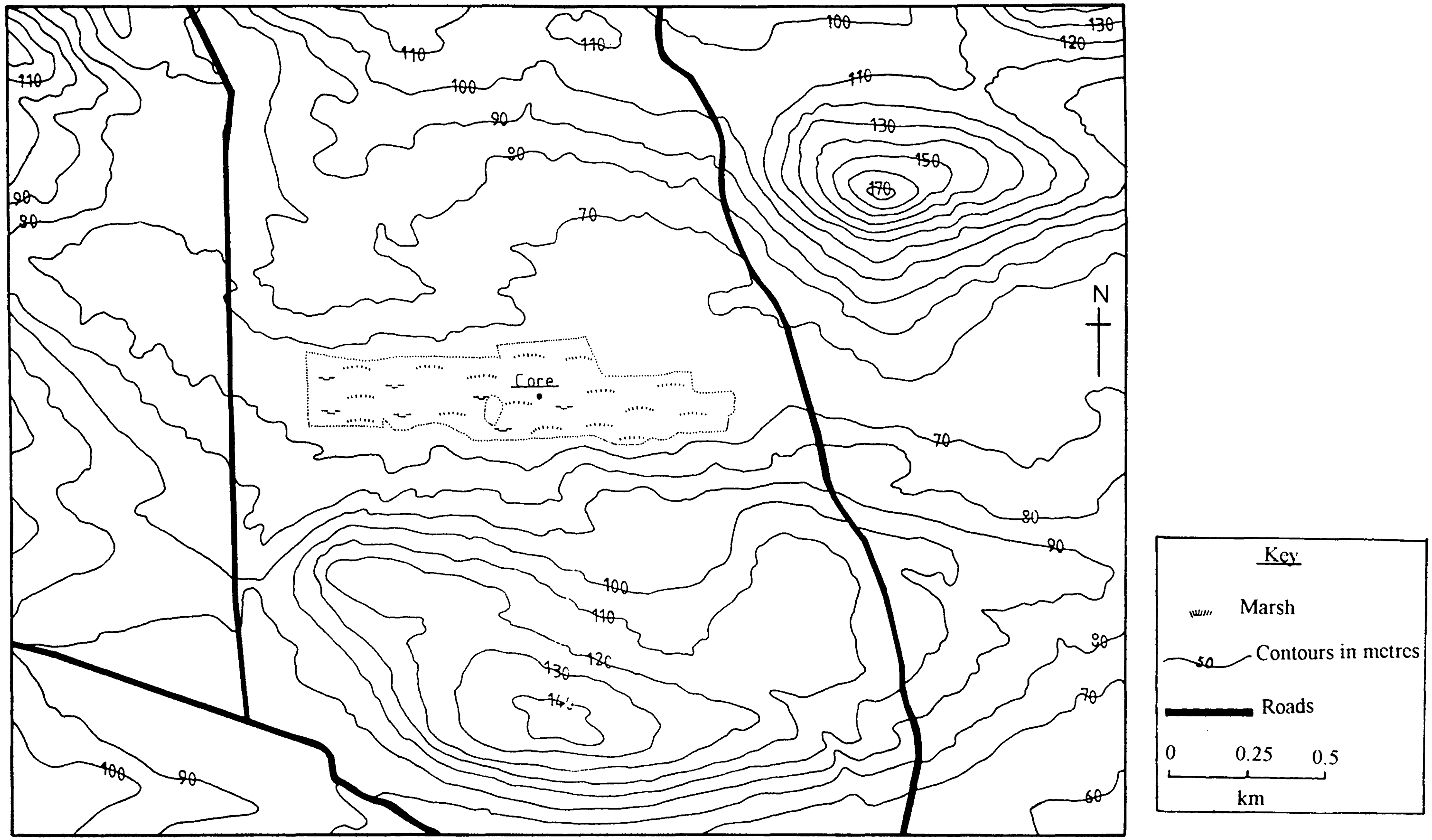


Plate 4 - A view of the Pitbladdo site looking north. The site is located in the area of pasture in the centre of the plate.

Plate 5 - A view of the Pitbladdo site looking north - east, showing the angle of slope and a distant view of Lordscairnie Castle.

and is surrounded by arable land. A network of buried drainage pipes, installed in the 1980s, has improved drainage sufficiently to allow silage production across the site.

The site was first investigated by Donald (1981). This study was based upon a wide sampling interval and included no dating controls. However, the study highlighted the sites potential and indicated the presence of a complete Holocene sedimentary record. On the basis of the preliminary field work undertaken at this site and the available published data, this site was considered ideally suited for further detailed investigation.

Core transects across the bog surface (at 200 m intervals east to west, and 50 m intervals north to south) indicated that the deepest deposits were located in the central area of the bog, and it is from this location that cores were extracted (figure 5).

1:3:3 - Methvern.

The site at Methvern (NOGR 011 237) is located on the floor of a gently sloping valley at a height of 40 m OD (figure 6, plate 6), approximately 7 km west of Perth (figure 3). The site occupies an area of approximately 1375 m by 425 m and is separated from the surrounding arable land by a fringe of planted trees (plates 6 and 7), some of which are beginning to encroach upon the site (plate 8). The site currently supports a marsh plant community (plate 9) containing a number of rare plants (e.g. *Drosera rotundifolia*) and is a designated S.S.S.I.

The site was previously investigated by Erdtman (1928), Durno (1976) and Dickson (pers. com.), who obtained two radiocarbon dates. Previous studies were based upon wide sampling intervals and incorporated only limited dating controls. The general nature of these studies was sufficient to highlight the site's potential, but left considerable scope for further palaeoecological research.

Core transects across the bog surface, at 200 m intervals south-west to north-east and 100 m intervals north-west to south-east, indicated that the deepest deposits were located in the central area of the bog, and it is from this location that cores were extracted (figure 5).

1:3:4 - Cleek Howe.

The site at Cleek Howe (NOGR 438 281) is located on the floor of an asymmetrical valley at a height of 50 m OD, approximately 1.5 km west of Tayport and 15 km north-east of Cupar (figure 3). The site occupies an area of approximately 250 m by 50 m and currently supports a marsh community with a central area of standing water. The site is separated from the surrounding pasture land by a channelled burn and an outcrop of bedrock (Craig Law).

Preliminary investigations (table 1) suggested that this site had considerable potential. Core transects across the site, at 50 m intervals south-west to north-east, indicated that the deepest deposits were located in the north-east of the site, and it is from this area that cores were extracted.

Analysis of a series of pollen counts spanning one of the cores produced a diagram

Figure 6 showing the location of the site at Methvern and the area from which samples were extracted.

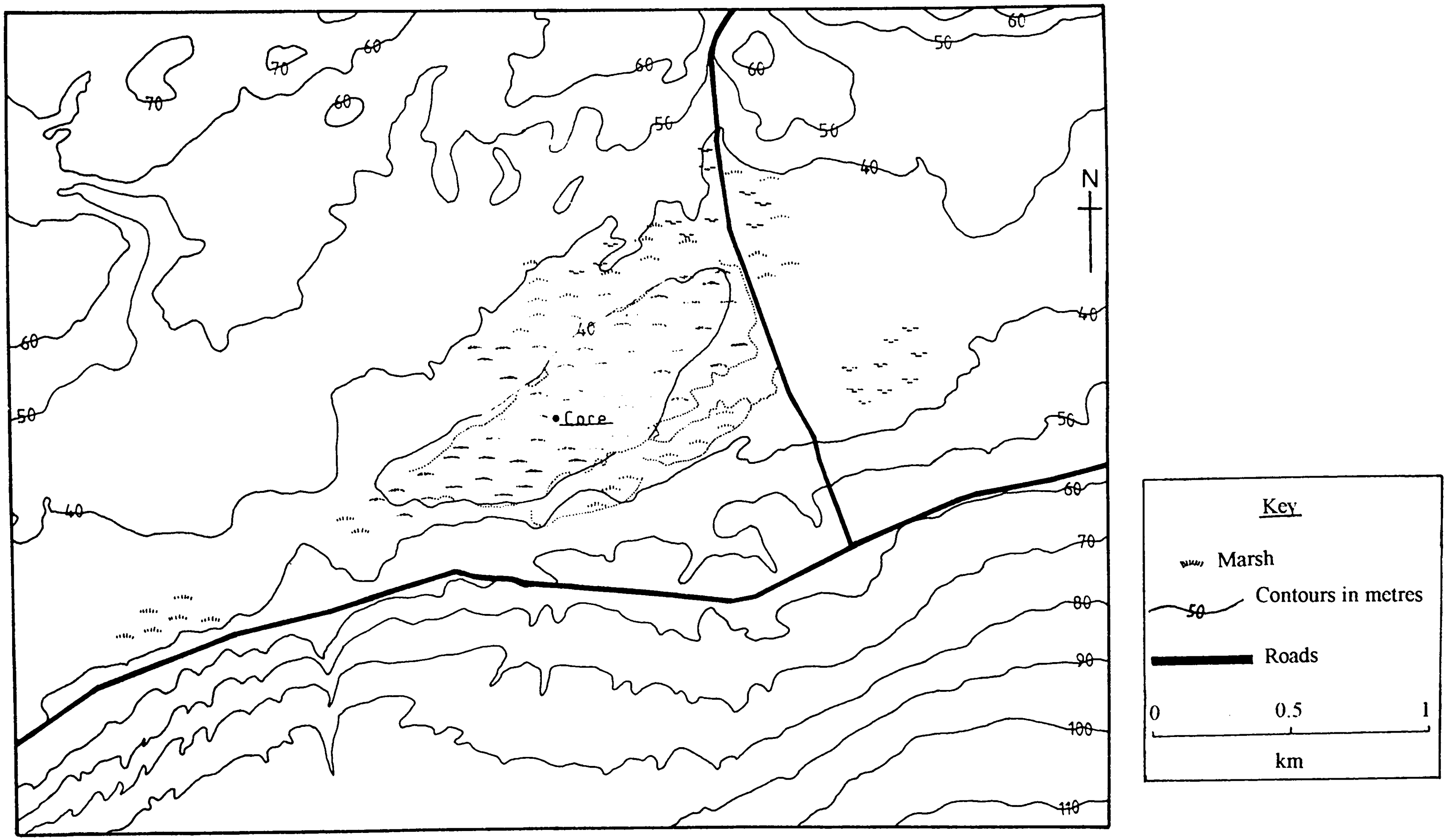


Plate 6 - A distant view of Methvern Moss from the east. The site is bordered by a fringe of trees.

Plate 7 - The view from the coring site at Methvern looking north, showing the fringe of trees surrounding the bog.

Plate 8 - The view from the coring site at Methvern looking east, showing the encroachment of trees onto the site

Plate 9 - The surface vegetation at Methvern

containing no clear patterns of change. The absence of any clear patterns of either woodland development or clearance suggested that the sediments at this site were not *in situ*, and had been subject to significant disturbance and mixing, although the source of this disturbance remains unclear. On the basis of the pollen analysis undertaken it was considered that any results would have been of little interpretational value and work was discontinued on sediments from this site.

1:4 - General geology of the study area.

It is generally recognised that there is a close relationship between the distribution of soils and the underlying rock or drift deposits of an area. The geological deposits form the parent material from which the overlying soils are developed. Sections 1:4:1 and 1:5:1 give brief accounts of the geology and soils surrounding the sites under investigation.

The study area is located within the Midland Valley of Scotland (figure 7). This region has the structure of 'an ancient rift valley or graben' (Cameron and Stephenson 1985 p.1). Within this geologically distinct region there is a high degree of physiological diversity (figure 8).

Two of the sites, Cruvie and Pitbladdo, lie within an area of extensive igneous rocks, predominantly Andesitic and Basaltic lavas and tuffs dating from the Lower Devonian. The third site, Methvern, is located in an area of Lower Old Red Sandstone, also dating from the Lower Devonian. The solid geology at all three sites is overlain by extensive till deposits comprised of a compact sandy clay containing clasts of local rocks and far-travelled erratics, interspersed with areas of exposed bed-rock, alluvium and Late-glacial marine and glacial meltwater deposits.

1:4:1 - Site geology.

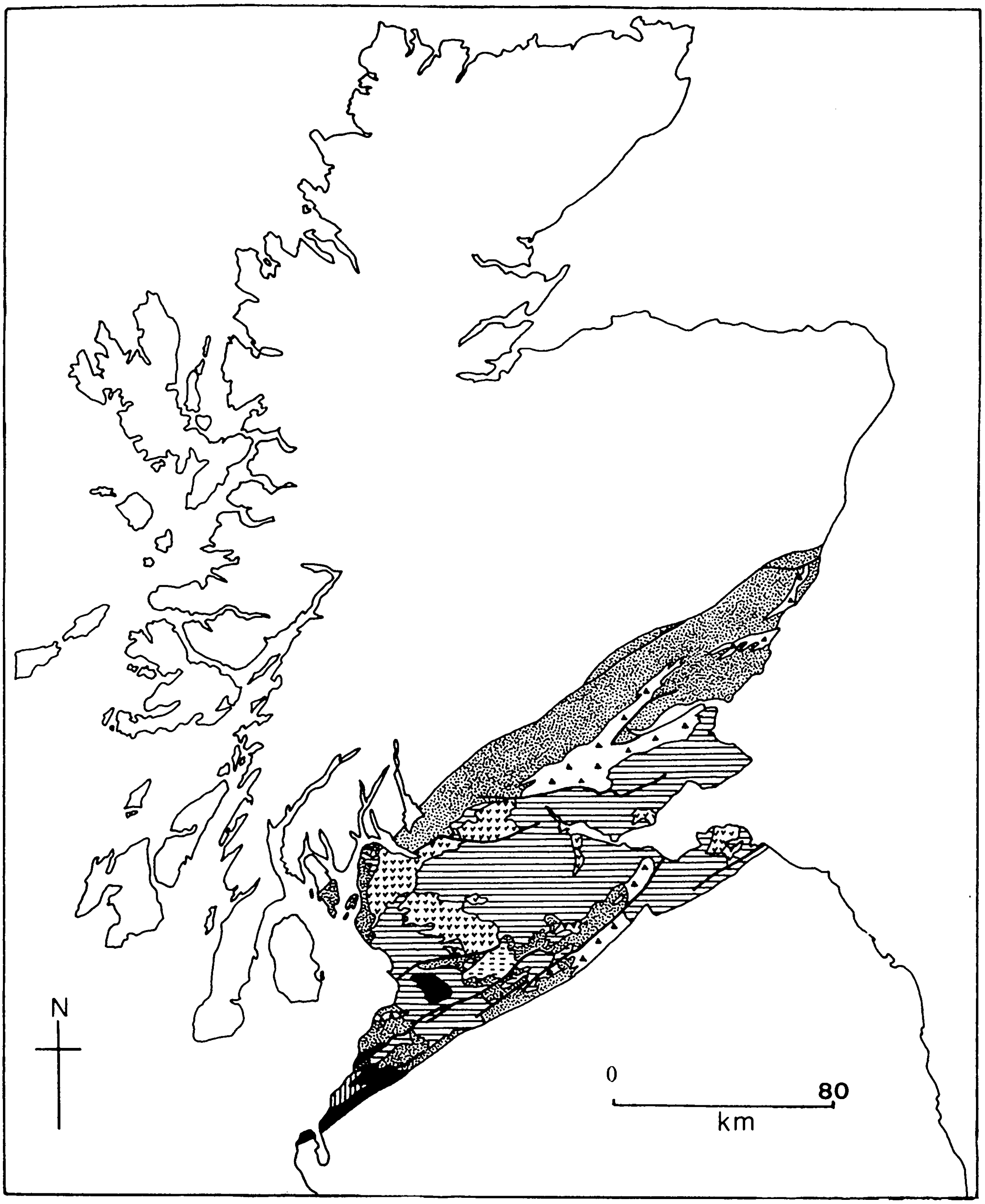
1:4:1:1 - Cruvie.

The area surrounding Cruvie is dominated by igneous rocks dating from the Lower Devonian, the only exception being a small area of intrusive quartz-dolerite dating from the Permo-Carboniferous, located 0.5 km from the coring site (figure 9). The study site is underlain by an area of extrusive andesite and basalt. Bordering the site to the north west is an area of rhyolitic agglomerate, an intrusive vent formation, whilst to the south is an area of intrusive felsite.

Other features of the local area (figure 9) include areas of extrusive igneous rocks (trachyandesite and basalt with feldspar phenocrysts), areas of intrusive igneous rocks (felsite and acid porphyrite) and two areas of sedimentary deposits (volcanic conglomerate, derived mainly from andesite and basaltic lavas and undivided cross-bedded sandstone).

Overlying the solid geology is a kettle-hole feature, formed as a result of the melting of an isolated ice block within glacial meltwater deposits following deglaciation (Price 1983). Within this depression peat-like sediments were deposited (figure 10), and these sediments define the study site at Cruvie. Surrounding the site is an area of till, comprised of compact sandy clay containing clasts of local rocks and far-travelled erratics. Other local features include areas of bedrock (rhyolitic

Figure 7 The geology of the Midland Valley.



After Craig (1991).

Sedimentary rocks

Devonian Old Red Sandstone (including volcanic areas).

Carboniferous (including small volcanic areas).

Lower Palaeozoic (undivided).

Igneous rocks

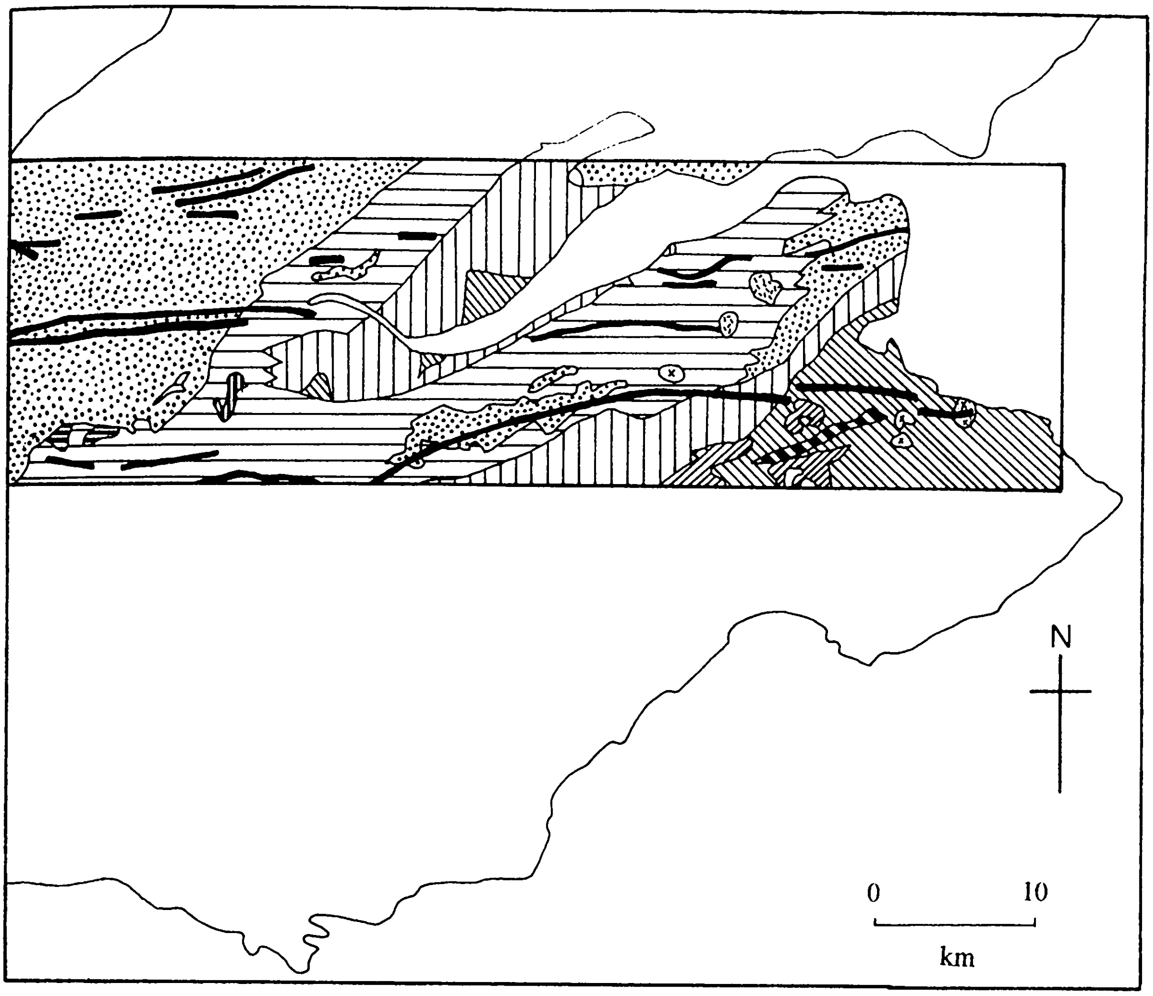
Devonian volcanics.

Carboniferous volcanics.

Metamorphic rocks

Locheil Group.

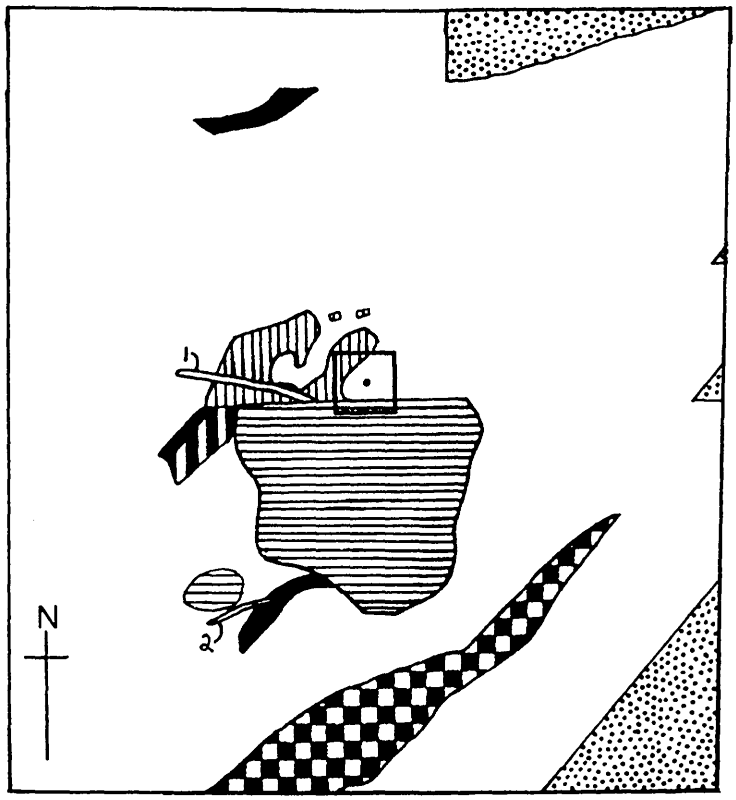
Figure 8 The general geology of the study area.



Source: I.B. Cameron and D. Stephenson 1985.

Basalt, dolerite and allied types.	
Lower Devonian.	Dinantian (Carboniferous Limestone Series).
Upper Devonian.	Basalt, dolerite and allied types.
Andesitic and basaltic lavas and tuffs.	Namurian (Millstone Grit Series).
Agglomerate in neck.	Rhyolite, trachyte and allied types.
Rhyolite, trachyte, felsite and allied types.	Tuff (including ignimbrite).

Figure 9 The detailed solid geology of the area surrounding Cruvie.



Source: BGS 1980

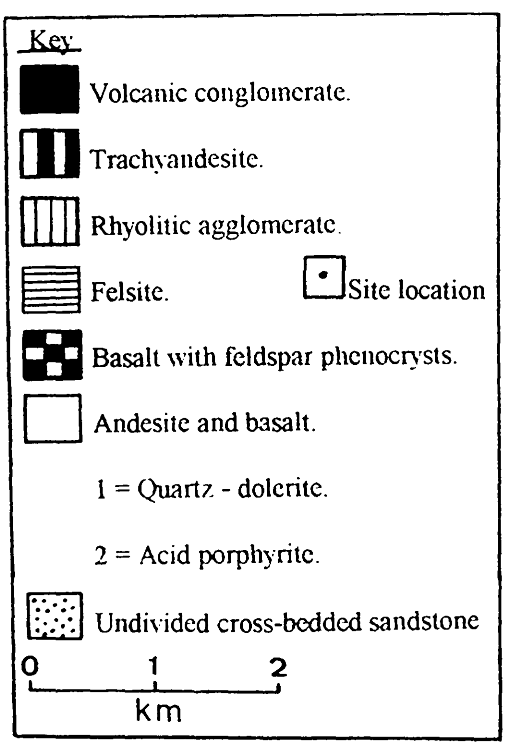
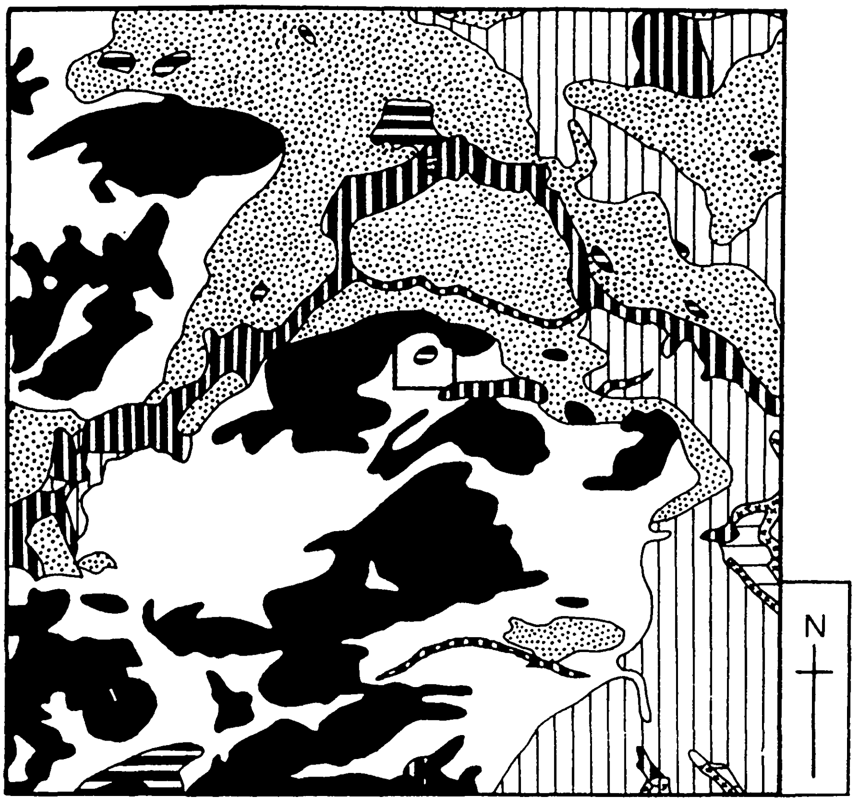
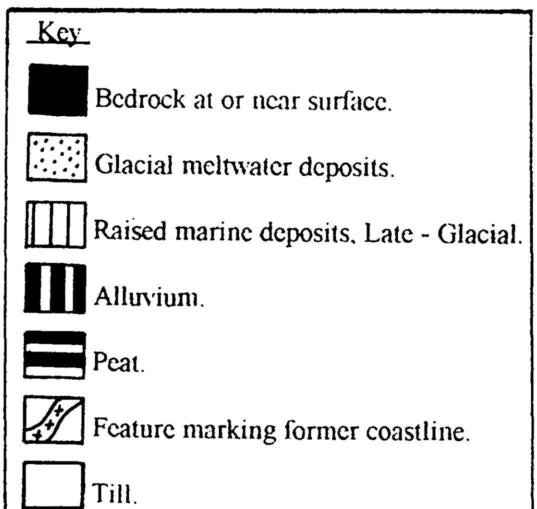


Figure 10 The detailed drift geology of the area surrounding Cruvie.



Source: BGS 1980



agglomerate and andesite and basalt), alluvium, glacial meltwater deposits, comprised of sand and gravel, and to the east of the site an extensive area of Late-glacial raised marine deposits, including littoral sand and gravel and subtidal clay.

1:4:1:2 - Pitbladdo.

The area surrounding Pitbladdo is also dominated by igneous rocks dating from the Lower Devonian, with the exceptions of three areas of Lower Devonian sedimentary volcanic conglomerate, located to the south and east of the site, and two areas of Permo-Carboniferous intrusive igneous quartz-tholeiite, located to the north. The site is underlain by an area of extrusive andesite and basalt and bordered to the south by an area of extrusive tuff and agglomerate (figure 11) The remaining formations recorded in the local area are either extrusive (trachyandesite, basic pyroxene-andesite, hornblende-andesite) or intrusive (microdiorite, microgranodiorite, felsic alkaline, dacite, acid porphyrite) igneous rocks.

Overlying the solid geology is an area of extensive till. The study site is positioned within the till and defined by an area of peat surrounded by a margin of alluvium (figure 12). The site is located in a valley bottom and it is considered likely that peat formation began when the deposition of till to the east of the site impeded natural drainage. Other local features include outcrops of bedrock (including tuff and agglomerate, andesite and basalt and basic pyroxene-andesite), small isolated pockets of peat and alluvium, and several areas of glacial meltwater deposits, to the east of the site, comprised of sand and gravel.

1:4:1:3 - Methvern.

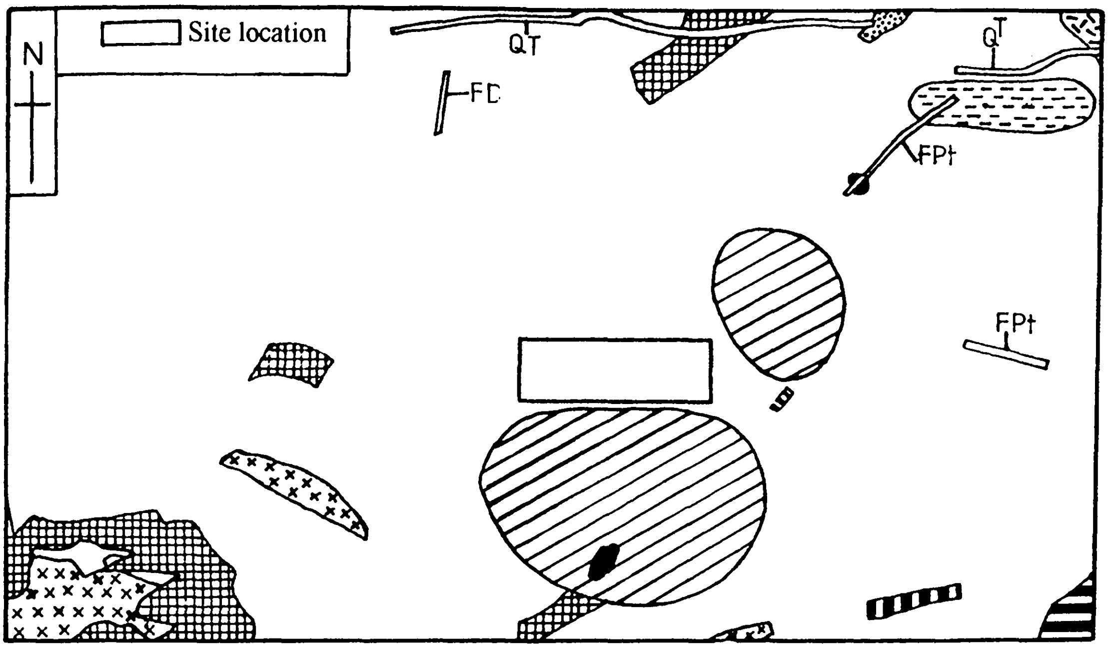
In contrast to Cruvie and Pitbladdo, which are both underlain by Lower Devonian igneous rocks, Methvern is located in an area that is dominated by Lower Devonian sedimentary rocks. (figure 13). Underlying the site is an area of undivided cross-bedded sandstone, whilst to the north and east of the site is an area of sandy and poorly sorted mudstone. To the south of the site are a series of igneous intrusive quartz-dolerite dykes, dating from the Permo-Carboniferous.

Overlying the solid geology is an area of extensive till comprised of a compact sandy clay containing clasts of local rocks and far-travelled erratics. Within the till is an area of peat which forms the study site (figure 14). This peat deposit and the area of alluvium positioned immediately to the east are located in the base of a valley, and it is considered likely that peat development began when the deposition of Late-glacial raised marine and associated glacial meltwater deposits (to the north and east of the site) impeded natural drainage.

1:5 - Soils - Introduction.

Soil development is influenced by a range of factors including parent material (determined by the underlying geology), variations in hydrologic conditions, slope, aspect and altitude. Four

Figure 11 The detailed solid geology of the area surrounding Pitbladdo.



Source: BGS 1983

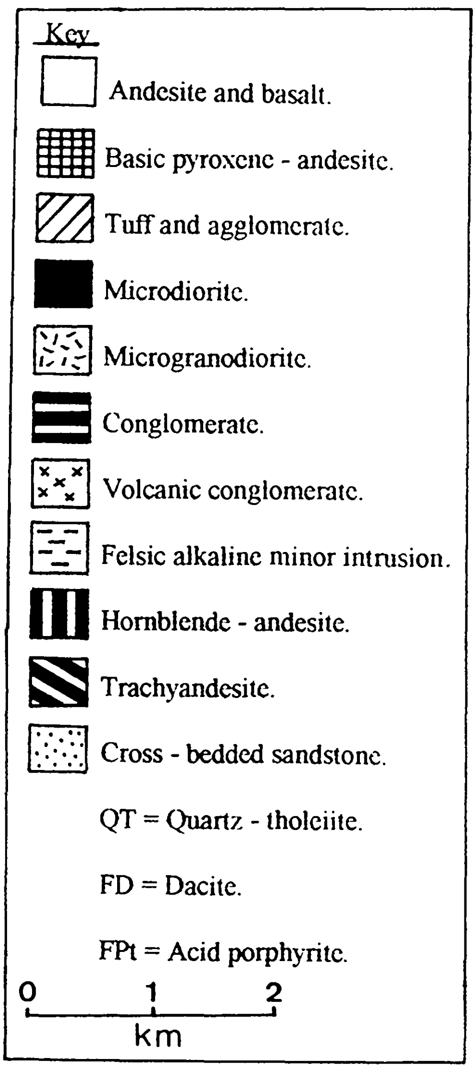
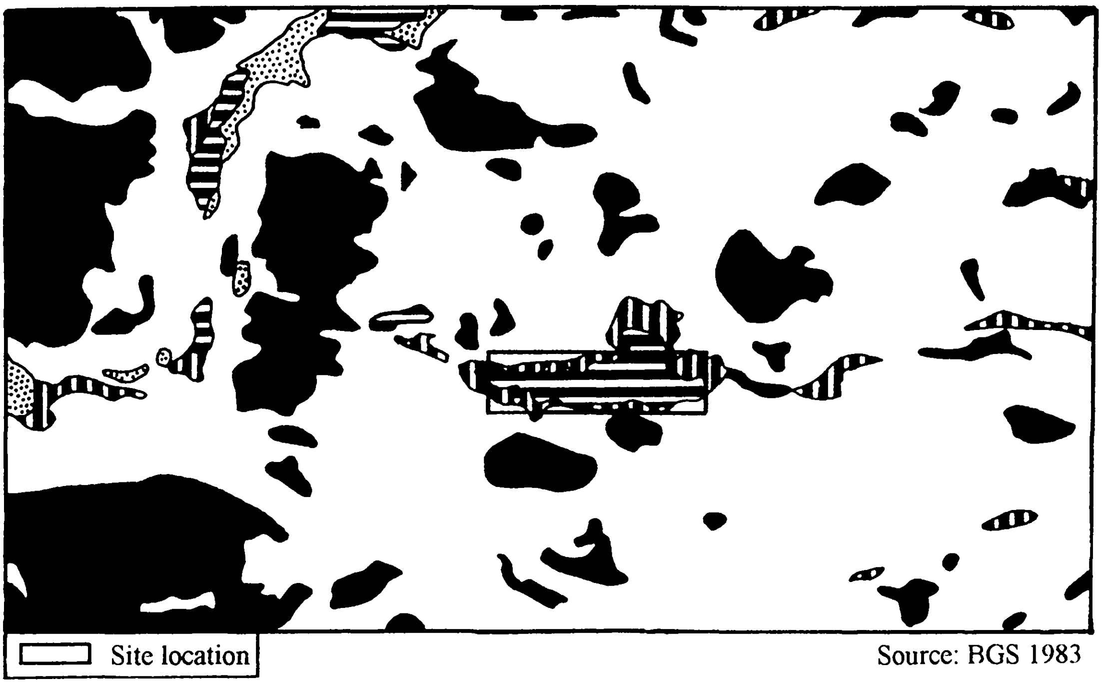


Figure 12 The detailed drift geology of the area surrounding Pitbladdo.



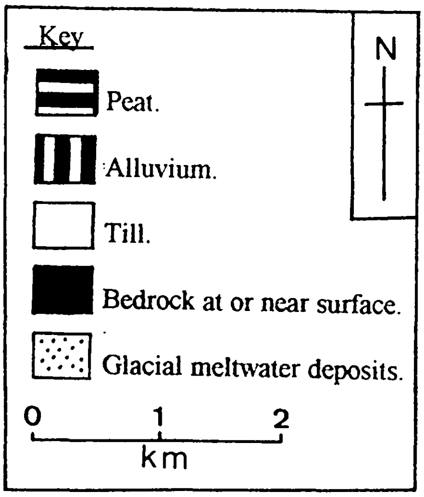


Figure 13 The detailed solid geology of the area surrounding Methvern.

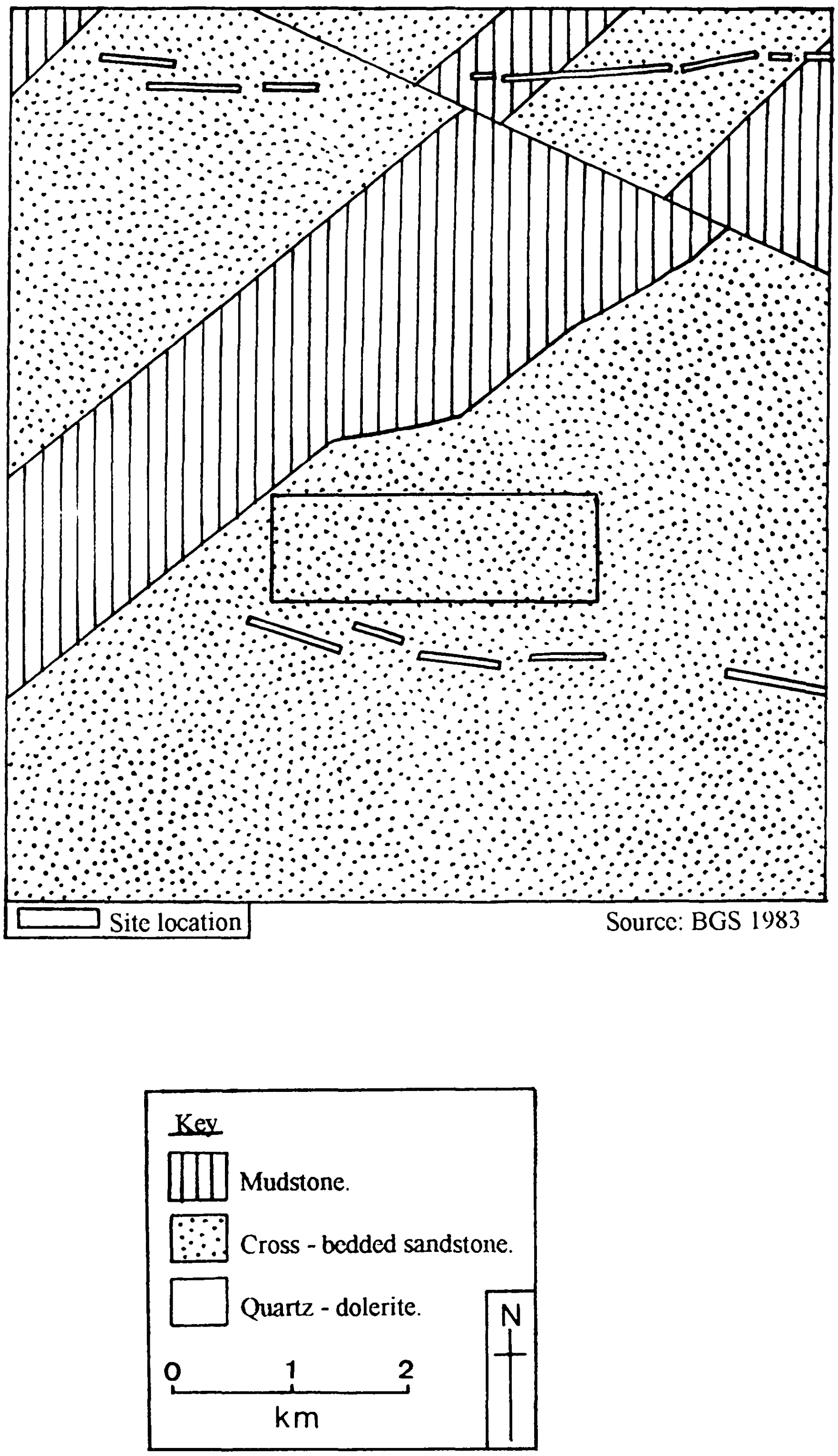
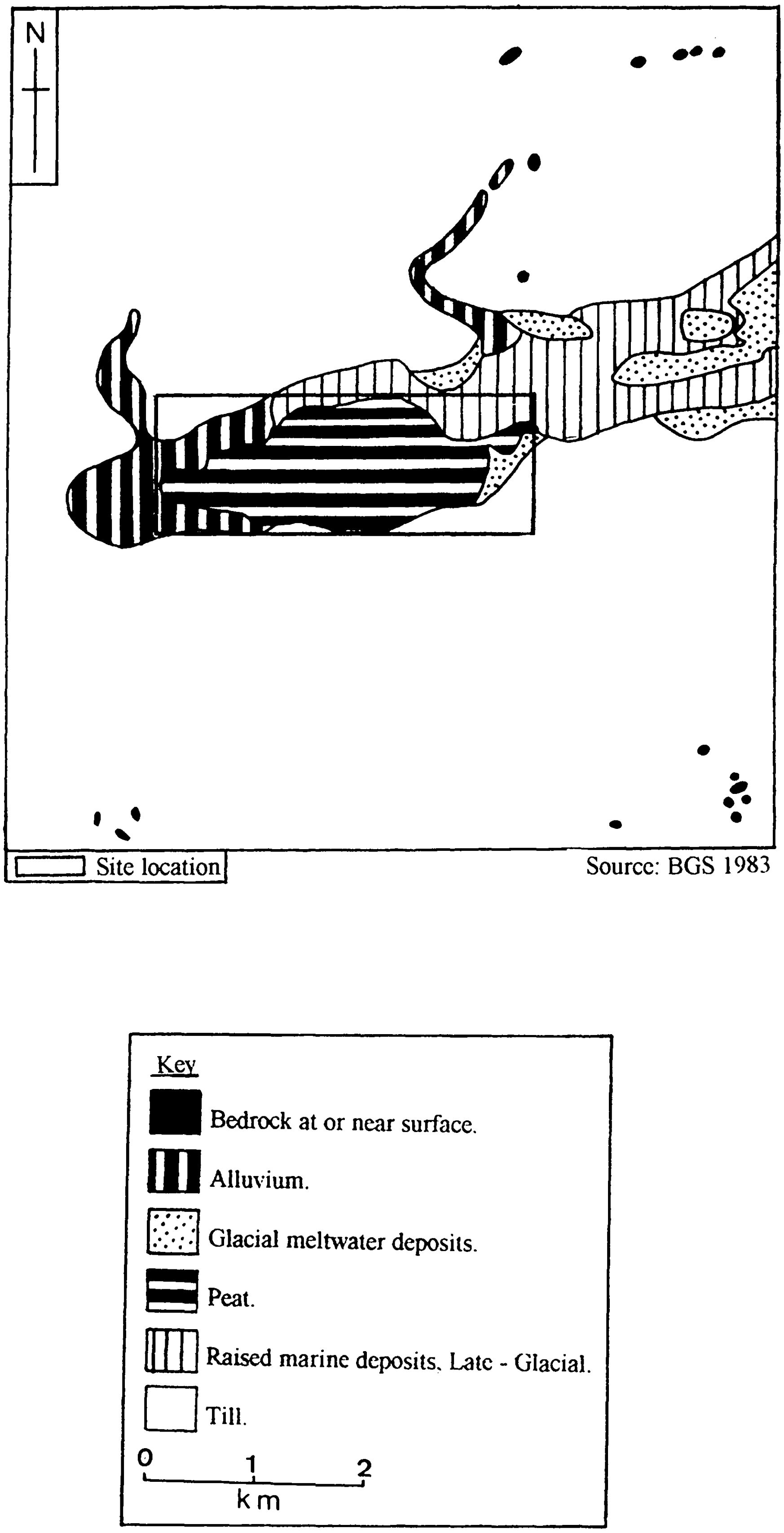


Figure 14 The detailed drift geology of the area surrounding Methvern.



major soil groups, Brown Earths, Podzols, Surface-water Gleys and Ground-water Gleys (Laing 1976 p.35), occur within the area of Northern Fife and Southern Perthshire. Each of these groups can be divided into sub-groups and associations and comprises of a range of soil series, each with unique characteristics, formed in response to local variations in environmental conditions.

A total of 26 soil series belonging to 14 associations occur within a three mile radius of the three sites. Sections 1:5:1, 1:5:2 and 1:5:3 detail the mosaic of different soil series recorded in the vicinity of each of the study sites and highlight the dominant soil groups and their land capabilities. Data presented in figures 16 to 20 and tables 2 to 4 are based on information from a number of sources including publications of the Macaulay Land Use Research Institute. The source for all land capability classes was Laing (1976).

Although it is recognised that the patterns of soil distribution (figures 15 to 20) represent only the current point in a process of ongoing change, these patterns offer the best available guide to past soil distributions. It is argued that the attributes and land use capabilities of the different soil series may be used cautiously to provide a guide to past vegetation distribution and the location of areas favourable to human exploitation.

1:5:1 - Cruvie.

The area surrounding this site is dominated by Brown Forest Soils, Podzols and Alluvium, with smaller areas of Non-calcareous Gleys and Skeletal Soils (figure 15).These groups comprise 10 soil series (table 2) which together form the complex mosaic of soils shown in figure 16.

The site is located in an area of poorly drained Non-calcareous Gley of little agriculture value. The narrow strips of Alluvium to the north and the Brown Forest Soils that lie immediately adjacent to the site and dominate the area to the south and west have both been classified by Laing (1976 p.126) as land capability Class 2, that is

" Land with minor limitations that reduce the choice of crops and interfere with cultivation ."

The areas of Podzols dominant to the north of site, whose distribution mirrors that of the Glacial meltwater deposits recorded in this area, all fall within land capability Class 3, defined as

" Land with moderate limitations that restrict the choice of crops and/or require careful management " (Laing 1976 p126).

The current land classifications indicate that although all three of the groups are capable of sustaining agricultural activity the areas to the south of this site are of generally higher quality than those to the north. It is suggested that initial agricultural activity may have been focused upon the higher quality soils to the south of site, although at present there is no tangible evidence to support this proposal.

Figure 15 The general distribution of soil types in the area of Cruvie.

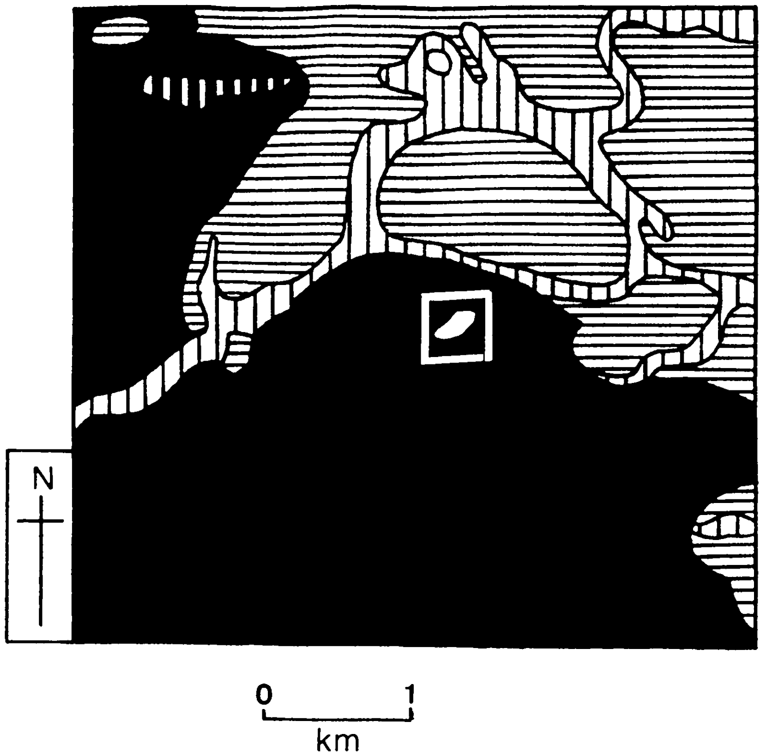


Figure 16 The detailed distribution of soil types in the area of Cruvie.

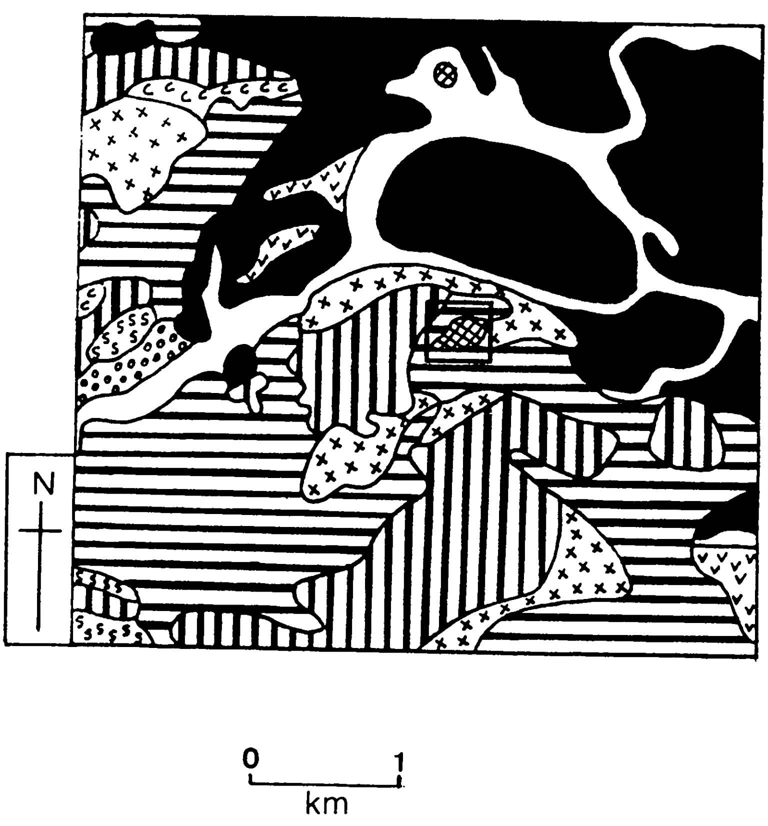


Table 2 Key to Cruvie Soil Maps.

A = General map | B = Detailed map. | Site location

A	B	Name	Series	Association	Parent Material
		Alluvium	Drainage undifferentiated	Alluvium	
		Auchenblae	Freely Drained Podzol	Auchenblae	Red sand and gravel
		Barras	Poorly Drained Non - calcareous Gley	Mountboy	Till derived from O.R.S. lava and sediments
		Bellshill	Imperfectly Drained Brown Forest Soil	Sourhope	Drifts derived from intermediate lavas of Lower O.R.S. age
		Carey	Imperfectly Drained Brown Forest Soil	Carpow	Upper Terrace deposits mainly fine sands and silts
		Garvock	Freely Drained Brown Forest Soil	Mountboy	Till derived from O.R.S. lava and sediments
		Kirkbuddo	Imperfectly Drained Podzol	Auchenblae	Red sand and gravel
		Mountboy	Imperfectly Drained Brown Forest Soil	Mountboy	Till derived from O.R.S. lava and sediments
		Skeletal Soil	Skeletal Soil with occasional rock outcrops	Sourhope	Drifts derived from intermediate lavas of Lower O.R.S. age
		Sourhope	Freely Drained Brown Forest Soil	Sourhope	Drifts derived from intermediate lavas of Lower O.R.S. age

Source: Soil Survey of Scotland 1983

1:5:2 - Pitbladdo.

The site at Pitbladdo is comprised of an area of Basin Peat bordered to the north by a narrow strip of Alluvium. The area surrounding the site is dominated by land capability Class 2 Brown Forest Soils, with smaller pockets of Class 2 Alluvium, Class 3 Non-calcareous Gleys and Skeletal Soils of little agricultural value (figure 18). These groups comprise seven soil series belonging to four associations (figure 19 and table 3).

All of the soils series (with the exception of the Basin Peat) recorded at this site also occurred in the area surrounding Cruvie. However, the extensive areas of Class 3 Podzols recorded at Cruvie (figure 16) are absent from this site. It is suggested that the predominance of Class 2 Brown Forest Soils at Pitbladdo (figure 17) indicate that this site is more favourable to agricultural production than Cruvie.

1:5:3 - Methvern.

The site at Methvern comprises an area of Basin Peat. Immediately adjacent to the site are regions of land capability Class 2 Alluvium and Peat Alluvium Complex; whilst the surrounding area is dominated by Class 2 Brown Forest Soils, with smaller areas of Class 3 Non-calcareous Gleys and Class 3/4 Humus Iron Podzols (figure 19). These groups comprise 17 soil series belonging to 10 associations (table 4) which together form the complex arrangements shown in figure 20.

The majority of the soil series occurring in the area surrounding Methvern do not occur at either Cruvie or Pitbladdo, owing primarily to differences in parent material (see 1:4:1) However, the predominance of Class 2 soils at Methvern is similar to that recorded at Pitbladdo, making the two sites broadly comparable in relation to suitability for agricultural exploitation. It is suggested that if initial agricultural activity was focused in areas containing the best soils, the areas surrounding Pitbladdo and Methvern are likely to have been utilised at earlier date than the area surrounding Cruvie.

1:6: - A brief consideration of past palynological research.

The history of palynological research in Scotland has been comprehensively reviewed in a number of papers including Edwards (1974), Caseldine (1980) and Walker (1984) and this section will not reiterate that discussion, but provide an overview of the research that has been undertaken in eastern lowland Scotland. Figure 21 shows the location of published pollen sites in eastern Scotland and highlights both the large number of studies and the wide geographical area covered. This area has a long history of palynological study beginning with Erdtman (1928), Godwin (1943), Durno (1956 1959) and continuing throughout the following four decades.

The number of sites shown in figure 21 suggests that this area of Scotland has been intensively investigated. However, the limited number of analyses, poor temporal resolution and limited dating controls of investigations at a number of these sites, primarily those dating from the

Figure 17 The general distribution of soil types in the area of Pitbladdo.

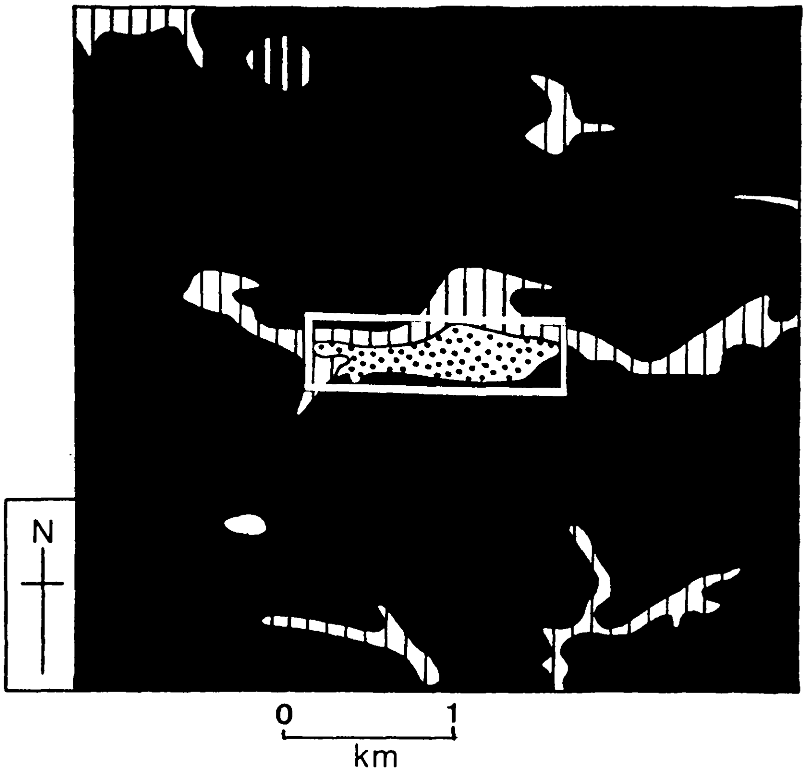


Figure 18 The detailed distribution of soil types in the area of Pitbladdo.

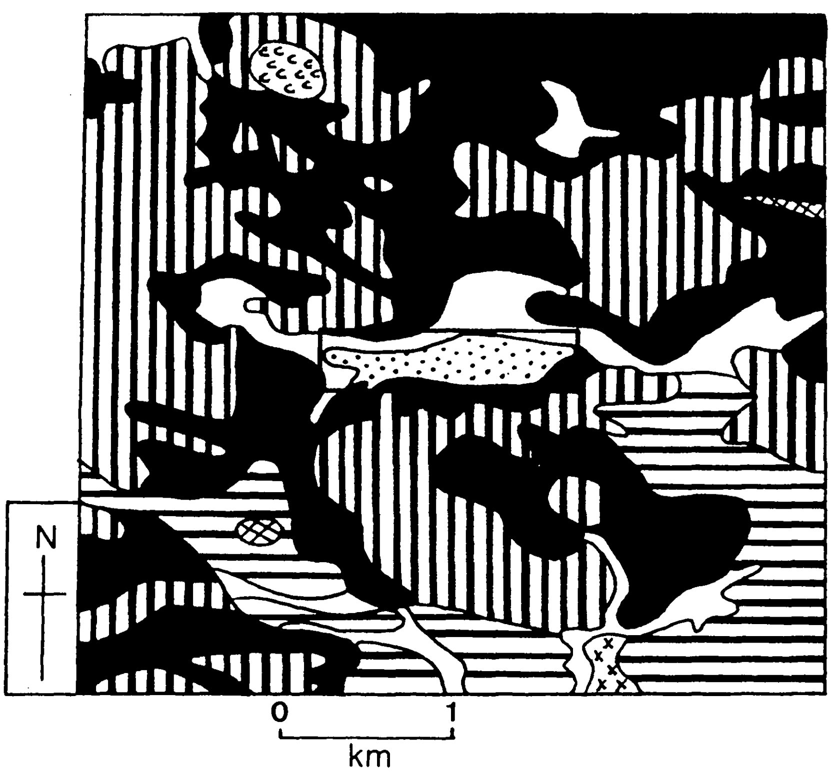


Table 3 Key to Pitbladdo Soil Maps.

A = General map | B = Detailed map. | ▭ Site location

A	B	Name	Series	Association	Parent Material
		Alluvium	Drainage undifferentiated	Alluvium	
		Barras	Poorly Drained Non - calcareous Gley	Mountboy	Till derived from O.R.S. lava and sediments
		Basin Peat	Organic Soil	Basin Peat	
		Bellshill	Imperfectly Drained Brown Forest Soil	Sourhope	Drifts derived from intermediate lavas of Lower O.R.S. age
		Garvock	Freely Drained Brown Forest Soil	Mountboy	Till derived from O.R.S. lava and sediments
		Skeletal Soil	Skeletal Soil with occasional rock outcrops	Sourhope	Drifts derived from intermediate lavas of Lower O.R.S. age
		Sourhope	Freely Drained Brown Forest Soil	Sourhope	Drifts derived from intermediate lavas of Lower O.R.S. age

Source: Soil Survey of Scotland 1983

Figure 19 The general distribution of soil types in the area of Methvern.

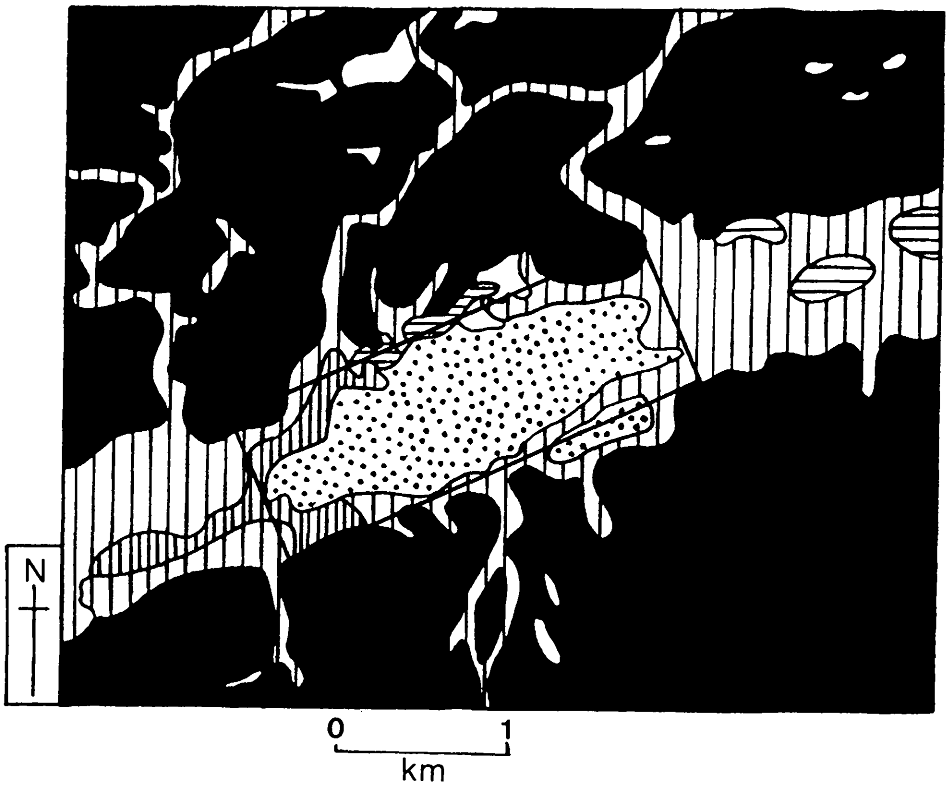


Figure 20 The detailed distribution of soil types in the area of Methvern.

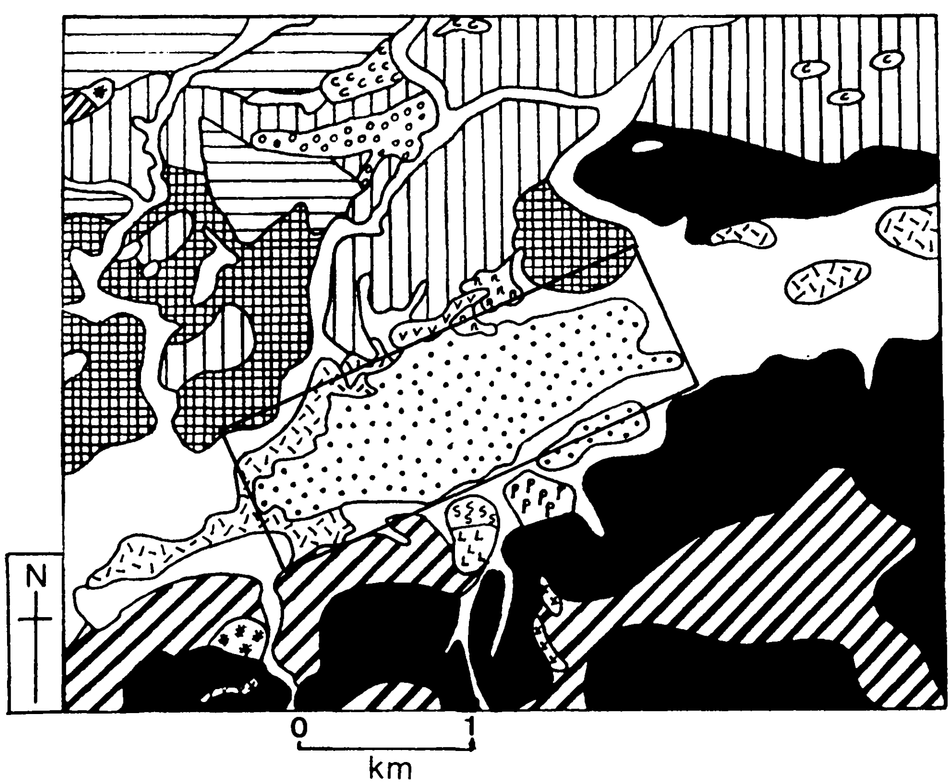


Table 4 Key to Methvern Soil Maps

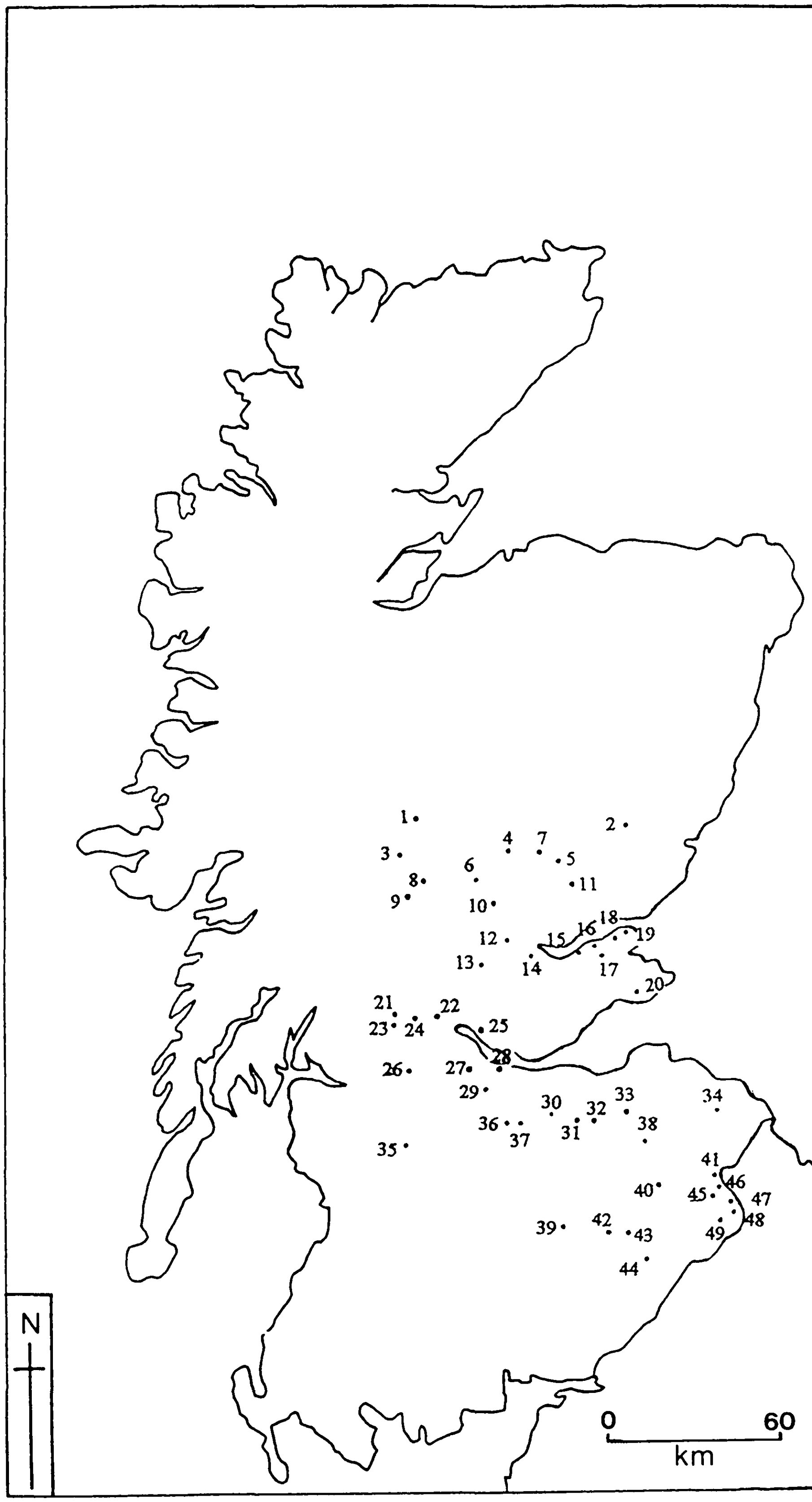
A = General map | B = Detailed map

Site location

A	B	Name	Series	Association	Parent Material
		Alluvium	Drainage undifferentiated	Alluvium	Alluvium
		Balrownie	Imperfectly Drained Brown Forest Soil	Balrownie	Till derived from Lower O.R.S. sediments
		Basin Peat	Organic Soil	Basin Peat	Basin Peat
		Buchanyhill	Freely Drained Brown Forest Soil	Balrownie	Till derived from Lower O.R.S. sediments
		Carbrook	Poorly Drained Non - calcareous Gley	Carbrook	Estuarine High Raised Beach silts and clays
		Darleith	Freely Drained Brown Forest Soil	Darleith	Drifts derived from basaltic lavas and intrusive igneous rocks
		Dunblane	Freely Drained Brown Forest Soil	Balrownie	Till derived from Lower O.R.S. sediments
		Gart	Freely Drained Humus Iron Podzol	Doune	Fluvioglacial sands and gravels derived from and Lower O.R.S. sediments
		Gleneagles	Freely Drained Humus Iron Podzol	Gleneagles	Fluvioglacial snds and gravels derived from Lower O.R.S. sediments
		Kippendavie	Imperfectly Drained Brown Forest Soil	Balrownie	Till derived from Lower O.R.S. sediments
		Laurencekirk	Imperfectly Drained Brown Forest Soil	Laurencekirk	Till derived from Lower Old Red Sandstone
		Lour	Poorly Drained Non - calcareous Gley	Balrownie	Till derived from Lower O.R.S. sediments
		Luther	Imperfectly Drained Brown Forest Soi	Laurencekirk	Till derived from Lower Old Red Sandstone
		Muirfoot	Poorly Drained Non - calcareous Gley	Laurencekirk	Till derived from Lower O.R.S. sediments
		Oldcake	Freely Drained Brown Forest Soil	Laurencekirk	Till derived from Lower O.R.S. sediments
		Peat Alluvium Complex	Alluvial Soil	Peat Alluvium Complex	
		Vinny	Freely Drained Humus Iron Podzol	Forfar	Water sorted material overlying till

Source: Soil Survey of Scotland 1983

Figure 21 showing the location of published pollen sites in eastern lowland Scotland.



Source: Various individual studies and Tipping 1994.

Table 5

Key to Figure 21 Pollen sites in eastern lowland Scotland

1	Drumochter (Walker 1975).
2	Laidwhinley (Durno 1959).
3	Black Wood of Rannoch (Hayes 1967).
4	Clashgour (Walker & Lowe 1981) and (Bridge et al 1990).
5	Heatheryhaugh (Caseldine 1979).
6	Loch Creagh (Donner 1962).
7	Loch Mharaich (Caseldine 1979).
8	Lochan nan Cat (Donner 1962).
9	Creag na Caillich (Edmonds et al 1992) and (Tipping et al 1993).
10	Dalnaglar (Durno in Stewart 1962) and (Durno 1965) and (Durno & Romans 1969).
11	Stormont Loch (Caseldine 1980) and (Caseldine 1993).
12	Methvern Moss (Erdtman 1928) and (Durno 1976).
13	North Mains (Hulme & Shirriffs 1985).
14	Loch Chon (Patrick et al 1990).
15	Black Loch (Whittington et al 1990 / 1991) and (Whittington & Edwards 1989 / 1990 / 1993) and (Edwards & Whittington 1990) and (Edwards 1990).
16	Creich Castle (Cundill & Whittington 1983).
17	Pitbladdo (Donald 1981).
18	Cruvie.
19	Pickletillem (Whittington et al 1991).
20	Kilconquhar Loch (Whittington & Jarvis 1986) and (Edwards & Whittington 1990) and (Whittington & Edwards 1989 / 1990).
21	West Flanders Moss (Turner 1965).
22	Auchtertyre Moss (Erdtman 1928) and (Godwin 1943).
23	Woodend Farm (Brooks 1972) and (Robinson 1993).
24	Flanders East Moss (Durno 1956).
25	Letham Moss (Dumayne 1992 / 1993) and (Barber et al 1993).
26	Campsie Fells (Eydt 1958).
27	Fannyside Muir (Dumayne 1992 / 1993).
28	Darnrig Moss (Durno 1956).
29	Drumbow Moss (Dickson 1988).
30	Kitchen Moss (Newey 1967).
31	Upper Eddleston Valley (Newey 1967).
32	Side Moss (Newey 1967).
33	Fala Moss (Durno 1976).

Table 5 continued

Key to Figure 21 Pollen sites in eastern lowland Scotland.

34	Dogden Moss (Dumayne 1992 / 1993) and (Barber et al 1993).
35	Peel Hill (Durno 1962) and (Durno 1965).
36	Cranley Moss (Dumayne 1992 / 1993) and (Barber et al 1993).
37	Carnwath moss (Fraser & Godwin 1954).
38	Threepwood Moss (Durno 1976) and (Mannion 1980).
39	Loch Skene (Erdtman 1928).
40	Blackpool Moss (Butler in Rideout & Owen 1992).
41	Din Moss (Hibbert & Switsur 1976).
42	Kingside Loch (Tight 1987).
43	Wester Branxholme Loch (Tight 1987).
44	The Dod (Shennan & Innes 1986) and (Innes & Shennan 1991).
45	Linton Loch (Mannion 1978 / 1982).
46	Yetholm Loch (Tipping 1992).
47	Swindon Hill (Tipping 1992).
48	Sourhope (Tipping 1992).
49	Mow Law (Tipping 1992).

earliest period of palynological research, has resulted in the need for further detailed work that will complement and expand upon the existing studies.

1:6:1 - Outline of previous palynological studies.

In recent years a number of palynological studies has been undertaken in the area of northern Fife and southern Perthshire (figure 21) and it might be argued that there is little need for further work to be undertaken in this relatively small area. However, the studies undertaken indicate that the palaeoecological history of this area of Scotland is extremely complex and synchronicity between events cannot be assumed across even limited distances. It is only through the investigation of further sites, and the integration of information from these sites that an accurate picture of both the vegetational history and the nature and extent of human activity during the Holocene will emerge.

To date a total of 12 papers relating to study of the Holocene vegetation record (from five sites) has been published from within the study area (table 6). Other studies considering modern patterns of pollen distribution (Caseldine 1981) and the links between land-use and lake acidification (Patrick *et al.* 1990) have also been undertaken in the study area. This section outlines the type of research undertaken at each of the five sites and highlights key findings.

Table 6 Published palynological studies from within the study area

Site	Author(s)
Pitbladdo	Donald (1981).
Pickletillem	Whittington *et al.* (1991).
Creich Castle	Cundill and Whittington (1983).
Black Loch	Edwards (1990), Edwards and Whittington (1990), Whittington and Edwards (1989), Whittington and Edwards (1990), Whittington and Edwards (1993), Whittington *et al.* (1990), Whittington *et al.* (1991).
Methvern Moss	Erdtman (1928), Durno (1976).

The study undertaken at Pitbladdo (Donald 1981) used a wide sampling interval and included no dating controls. The author proposed that the site contained a complete Holocene sequence. recording patterns of woodland development, anthropogenic activity and consequent deforestation. However, subsequent analysis of this site during this project (incorporating radiocarbon dating controls and close interval sampling) has shown that it does not contain a full Holocene record.

A detailed study carried out on deposits recovered from a lowland former kettle hole at Pickletillem (Whittington *et al.* 1991) incorporated close interval sampling (4 cm) and good dating controls, based on 11 radiocarbon dates. The site contained a full Holocene record and allowed the reconstruction of a detailed vegetation history. The paper identified multiple *Ulmus* declines and highlighted the impact that location and soil conditions may have on the rates and nature of vegetation change. The paper suggested that the absence of archaeological artefacts does not indicate the absence of humans and underlined the role of palynology as a diagnostic tool.

A study of deposits at Creich Castle (Cundill and Whittington 1983) revealed a record relating to the late Devensian (ca. 12 000 BP) and early Holocene. Unusual pollen assemblages occur with a late Devensian dominated by *Pinus* and other thermophilous tree taxa, and an early Holocene, dominated by grasses until 8449 +/- 85 BP. The absence of deposits relating to the later Holocene is attributed to peat removal, possibly associated with the presence of a 13th to 18th century fortified house at the edge of the site.

Several studies have been undertaken at Black Loch (see above). The various published papers focus upon different aspects of the palaeoenvironmental record and this site is one of the most intensively investigated sites in eastern Scotland. A total of four sediment cores was recovered from the small lake (located in an ice deepened basin) and two of these cores spanned the Holocene.

The vegetation of the surrounding area was reconstructed for the Holocene and evidence for anthropogenic activity examined. The data indicate that evidence for Mesolithic activity is limited, that disturbances in the palynological record associated with human activity occur during the Neolithic, and that substantial landscape modification begins during the late Neolithic / early Bronze Age. A series of *Ulmus* declines was recorded at this site at ca. 5200 BP, 4940 BP and 4460 BP.

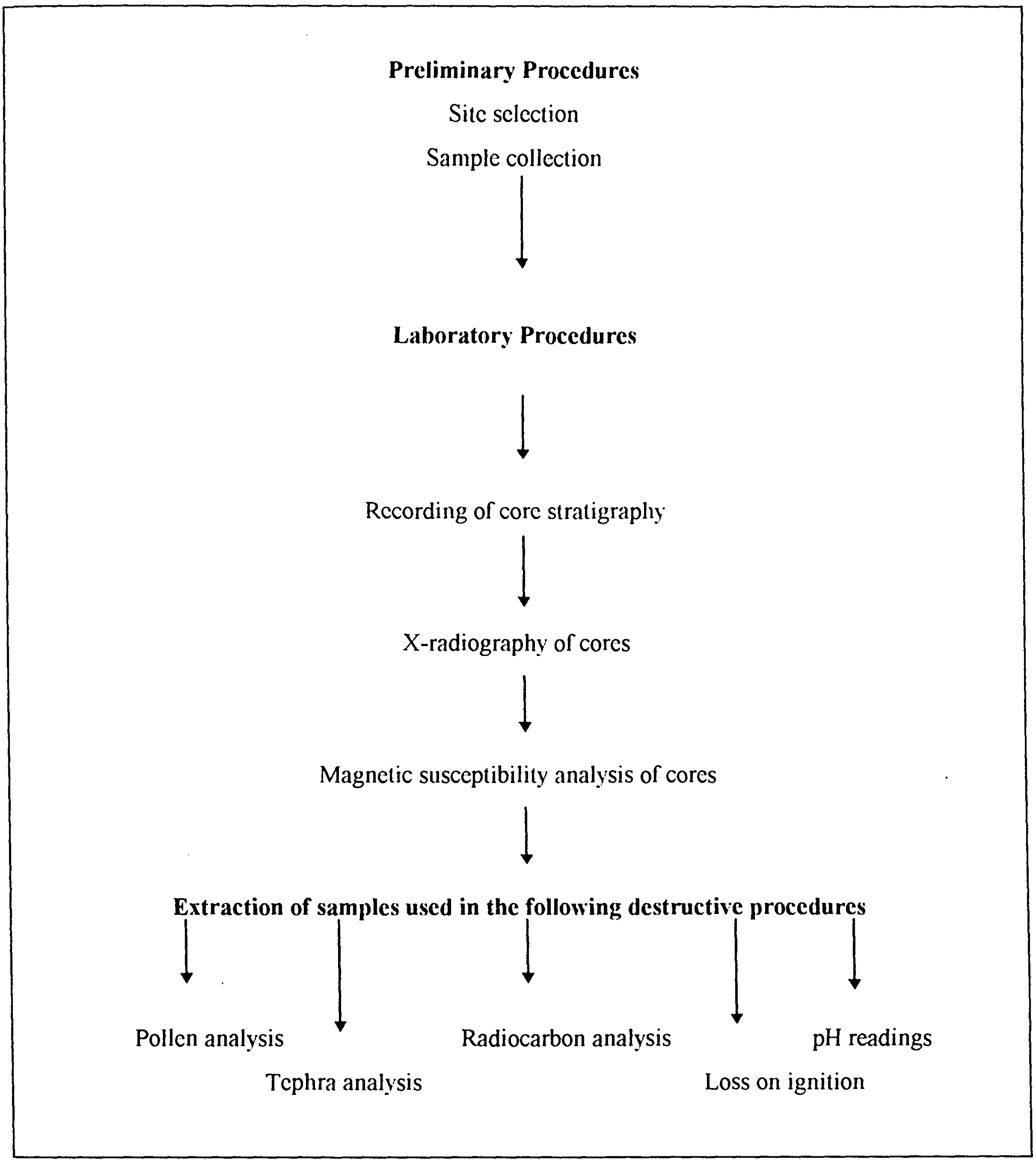
A total of 25 radiocarbon dates provides good dating control, although a number of reversals in the sequence of dates creates problems in establishing an accurate chronology for the site. The examination of multiple cores highlighted the influence that core location may have on the pollen profile, due to factors such as pollen recruitment, dispersal, concentration and preservation. The incorporation of sedimentary analyses into the investigations provided data that are absent from the majority of palynological investigations.

The two studies undertaken at Methvern (Erdtman 1928, Durno 1976) were both extremely limited in nature. The samples examined during these studies were at wide intervals and included no dating controls. The two papers indicated that the site contained a full Holocene record and highlighted its potential for further investigation.

The information provided by these publications has been used to enhance the discussion of the new data obtained in this study (Chapters five to eight) and provides a valuable additional source of comparative data.

Chapter 2 - Methodology

The schematic diagram below outlines the sequence of steps taken and the processing techniques used during this study. When possible all samples were extracted from a single sediment core in order to reduce the need for cross-core correlation.



2:1 - Site selection.

Potential sites were identified using the British Geological Survey 1:50 000 Drift Edition Geological maps of the study area. Areas classified as Peat deposits by the Geological Survey were visited in the field and further assessment undertaken. Table 1 shows the sites initially considered. During the field visits the potential sites were assessed in accordance with the following criteria:

a) Presence or absence of deposits. - Several potential sites no longer exist owing to recent changes in landuse. Agricultural and quarrying activity are primarily responsible for site destruction.

b) Degree of site degradation. - Sites that had undergone visible disturbance, cutting, drainage or burning were considered less likely to provide a complete and well preserved record than apparently pristine sites.

c) Sediment depth. - As a crude guide a correlation between depth and age was assumed. Sites with deep deposits were considered to have a greater potential than those with shallow deposits. Sediment depth was determined by trial coring along transects.

d) Site characteristics. - The following factors were considered during selection: the size of the site, the altitude of the site, drainage patterns and current landuse.

e) Archaeological information relating to the immediate area, such as the number and age of any known sites and finds and their location in relation to the site under consideration.

Trial coring along transects was undertaken at a number of potential sites to determine the extent of deposits (see table 1). The coring was undertaken using a 'Dutch' Gouge Auger fitted with a 1m long, 25 mm diameter coring chamber.

2:2 - Sample collection.

Coring was undertaken using a 'Russian' corer as described by Belekopytov and Beresnevich (1955) and Jowsey (1966), which has several advantages including minimal disturbance of sediments and easy removal of intact cores.

Four cores were recovered from each sampling point. Two cores were retrieved using a 1m long 5 cm diameter coring chamber and provided material for pollen and sedimentary analysis. The third and fourth cores were extracted using a 30 cm long 10 cm diameter coring chamber and these cores provided material for tephra analysis and radiocarbon dating. All cores were recovered from within a 1.5m area to aid in core correlation (see section 2:3:7).

2:3 - Sample preparation.

The plastic guttering containing the peat cores was sealed in plastic sheeting to avoid drying and clearly labelled on the outer layer to prevent unnecessary exposure of sediments during core selection. Cores were stored in a cold room at approximately 3°C to avoid the possibility of microbial activity resulting in pollen degradation.

Before sampling, the area around the sampling location was cleaned using a clean sharp scalpel; surface material was removed using horizontal movements to prevent contamination with material above or below the area being examined.

2:3:1 - Preparation of palynological samples.

Samples were initially taken at 16 cm intervals from each core, finer sampling being undertaken as required. The initial 16 cm interval followed that suggested by Moore *et al.* (1991), and allowed close interval sampling to be undertaken easily. Sediment required for pollen preparation was removed from the cores in 5 mm slices using a clean sharp scalpel. These slices were then mixed to produce an homogenous mass which was then subsampled.

In order to ensure that no biases were introduced during counting all samples were assigned a random sample number, and the position of the samples within the cores was only revealed once counting had finished.

The pollen preparation technique used was based on Andersen (1960), Erdtman (1960), Benninghoff (1962), Bonny (1972), Faegri and Iversen (1975), Berglund and Ralska-Jasiewiczowa (1986) Moore *et al.* (1991) and is described in detail in Volume Two Appendix One.

2:3:1:1 - Pollen counts.

Pollen and spore counts were undertaken using an Olympus BH2 series research microscope. Counting was carried out at 400x magnification with critical features examined at 1000x under oil.

Pollen was counted by linear traverses across the slide, in order to avoid any biases in pollen distribution (Brooks and Thomas, 1967). A basic counting sum of 300 identifiable land pollen grains was employed and pollen of obligate aquatic plants and unidentifiable grains were excluded from the sum. The number of 'exotic' pollen grains, in this case *Lycopodium clavatum,* added during preparation, was also recorded and expressed as number of exotics / 300 land pollen. These counts were later used in the production of diagrams illustrating changes in pollen concentrations.

The data tables upon which all pollen diagrams were based (including preservation information) are located in Volume Two Appendix Two. Basic data are included in this thesis in order to enable any future researchers to reassess / reinterpret this work on the basis of the original raw data.

2:3:1:2 - Pollen identification.

Identifications were based primarily on type reference material held at the Department of Archaeology, Edinburgh University, with further reference to several standard keys including Moore and Webb (1978), Andrew (1984), Faegri and Iversen (1989), Moore *et al.* (1991) and various volumes of The Northwest European Pollen Flora (including Punt 1975; Punt 1984; Punt and Malotaux 1984).

Cereal-type pollen grains were identified according to the criteria suggested by Andersen (1979), based upon the measurement of the a and b axis and annuli of uncrumpled grains. On the basis of these measurements Gramineae pollen was placed in the following categories (cf. Andersen 1979).

I) Wild grasses = Grain size < 37μm, mean annulus diameter , 8μm, surface scabrate or verrucate.
ii) *Hordeum* group = Grain size 32 - 45 μm, annulus diameter 8 - 10 μm, surface scabrate.
iii) *Avena - Triticum* group = Grain size > 40 μm, annulus diameter > 10 μm, surface verrucate.
iv) *Secale cereale* = Oblong grain, mean annulus diameter 8 - 10 μm, surface scabrate.

Owing to the difficulties of differentiating between the pollen grains of *Corylus avellana* and *Myrica gale* (Edwards 1981), a general Coryloid category was used during counting; although it is considered that hazel is the probable dominant throughout the Holocene at all of the sites investigated. Pollen assigned to the Coryloid category is referred to as *Corylus* throughout the main body of text. Other identifications follow the conventions described by Birks (1973 pp. 225-226). Nomenclature follows the conventions described by Clapham *et al.* (1989).

2:3:1:3 - Pollen preservation.

All pollen grains were assessed for deterioration during normal counting. Various authors have suggested a range of preservation categories (Cushing 1964, Tolonen 1980, Lowe 1982 and Delcourt and Delcourt 1980). During this study pollen grains were placed in the following categories after Delcourt and Delcourt (1980).

Normal - Well preserved grains, no indication of any degradation.

Corroded - The exine may be scored, etched, pitted or have complete perforations penetrating it. Indicates biological activity or chemical oxidation.

Degraded - The exine is generally thinned rather than locally perforated. Indicates chemical oxidation within aerial or subaerial environments.

Crumpled and split - These grains show signs of mechanical damage as a result of stress during physical transport and / or compaction of grains within sediments following deposition.

Other grains that were too poorly preserved to be identified were recorded as 'unidentifiable'. It was hoped that the preservation data would contribute to the interpretation of the sedimentary data, with the nature and degree of deterioration providing information on changing depositional conditions.

2:3:1:4 - Microscopic charcoal counts.

In addition to pollen and spores, fragments of microscopic charcoal were also counted. Charcoal is produced as a by-product of the burning of organic material and is frequently preserved in the sedimentary record "due to the fact that it is largely mineral and thus indestructible by microbial activity" (Evans 1978).

Changes in the representation of charcoal provide a record of changes in the relative importance of fire over time. However, this record does not indicate causal factors and the distinction between 'natural' and 'anthropogenic' fire signals is at best inferred. Interpretation is further hampered by our limited understanding of the sources of the microscopic charcoal recovered (Clark 1988), and of the effect that variations in site characteristics may have on charcoal representation (Tolonen 1986). The impacts that variations in the size and intensity of fires and the nature of plant communities burnt (e.g. woodland versus grassland) have on charcoal production (Johnson 1992) are also not presently fully understood. Despite these limitations the recording of microscopic charcoal provides a useful additional source of information and as the amount of data relating to this subject increases the value of microscopic charcoal as an interpretative tool will also increase.

Microscopic charcoal data may be obtained by chemical assay (Winkler 1985) or counted from slides prepared using standard palaeoecological techniques (Tolonen 1986) and presented in a number of different ways (see Clark 1982 and Patterson *et al.* 1987). In this study charcoal counts are expressed as number of charcoal fragments per 300 land pollen, producing a measure of relative charcoal frequency and as the number of units cm^{-3} wet sediment (charcoal concentration). During counting a minimum fragment size of 25 μm across the longer axis, based on graticule measurements was employed. This size division was chosen as

"the input of small charred particles less than 25μm in diameter from the atmosphere is apparently continuous in most areas", whilst "the larger fraction is then most indicative of (more or less) past fires in the local area" (Tolonen p.489 1986).

The use of 25μm lower limit aimed to improve the recognition of local fire events by limiting the degree of 'noise' created by the smaller fragments of charred particles. Charcoal data are appended to diagrams in the folder at the back of this volume and is presented in tabular form in Volume Two Appendix Two.

2:3:1:5 - Production of pollen diagrams.

All pollen diagrams were produced using the TILIA2 and TILIAGRAPH computer programmes produced by Eric Grimm of the University of Illinois. The nomenclature follows that of Clapham *et al.* (1989). The zonation of diagrams has been undertaken using various statistical approaches (Gordon and Birks 1972, 1974, Walker and Wilson 1978, Pittelkaw 1981, Birks and Gordon 1985, 1989); however,

"inspection of pollen diagrams, the original zonations and the results of numerical analysis shows that similar stratigraphical divisions are obtained by all numerical methods and the zonations derived at by statistical procedures correspond to those arrived at by visual inspection" (Gordon and Birks, 1972).

The diagrams produced in this study were visually divided into biostratigraphic zones, (local pollen assemblage zones) according to their percentage pollen content, each zone representing an area of the diagram with distinctive characteristics (Cushing 1967). Sub-zones were used to highlight episodes of change within zones. The diagrams were zoned primarily on the basis of changes in arboreal taxa, the exception being in areas of the diagram in which herbaceous taxa altered significantly, or in areas where arboreal pollen was not the dominant group.

The local pollen assemblage zones (LPAZs) are each prefixed by a letter designating the site (C = Cruvie, P = Pitbladdo and M = Methvern). LPAZs are labelled sequentially from the base of each core (a, b, c, etc.) and sub-zones are identified with lower case Roman numerals.

Percentage diagrams.

Values are expressed as a percentage of Σdry land pollen, and for non terrestrial taxa as percentage of Σ dry land pollen + Σ taxon. A pollen sum of 300 land pollen grains per sample was used at each of the sites studied. This figure was selected as a compromise between the need for high pollen counts for accurate data analysis, and high numbers of samples to provide an acceptable level of temporal resolution. Percentage diagrams are presented in figure 39 for Cruvie, figures 50, 52 and 54 for Pitbladdo and figures 65, 67 and 69 for Methvern. The diagrams are located in the folder at the back of this volume. Data tables showing counts upon which all diagrams were based are presented in Volume Two Appendix Two.

Absolute diagrams.

Pollen concentration per unit volume of wet sediment (grains / cm^3) and pollen accumulation rate per unit area of sediment surface per unit time (grains / cm^2 year) were calculated for all sites, using the following formula (Berglund 1986 p.462)

$$P_{conc} = \frac{\text{Spores added}}{\text{Spores counted}} \times \frac{\text{Fossil P}}{\text{Volume cm}^{-3}}$$

$$P_{influx} = P_{conc} \text{ X } v \text{ (grains / cm}^2\text{/ year)}$$

These calculations were carried out automatically using the TILIA2 programme. The calculation of the sediment accumulation rate for each site was essential for the calculation of pollen influx rates (see below). Owing to the uniformity of the sedimentation rates at all three sites, influx patterns mirror those of concentrations and are not depicted. Concentration diagrams for all sites are located in the folder at the back of this volume.

Calculation of time - depth sediment curves.

Time-depth curves were constructed for each of the sites under investigation based upon the available radiocarbon dates. Figures 32, 43 and 58 plot radiocarbon age against depth and sediment type. All of the dates were sequentially consistent and the mean age and mean depth of each sample are linked to its neighbours by straight lines. The sediment deposition times (*sensu* Davis 1969) between dated samples were calculated, and used to determine the probable mean age of each sample. Accumulation rates were also used in the calculation of pollen influx rates (see above).

2:3:2 - Measurement of Magnetic Susceptibility.

Although generally peat cores are low in magnetic mineral content (Oldfield *et al.* 1978), it has been noted that as "peaks in susceptibility correspond to horizons with high heavy-mineral concentrations" (Dearing 1986 p.317) they are a very useful parameter upon which to base core correlations and to identify periods of erosional activity or pedogenesis. For these reasons magnetic susceptibility readings were undertaken on all recovered cores, using a low-frequency core-scanning loop. A detailed description of the method employed may be found in Volume Two Appendix One. Results are presented in Chapters five to seven and in tabular form in Volume Two Appendix Two.

2:3:3 - Measurement of Organic material (Loss on ignition).

Loss-on-ignition measurements were carried out on cores from all of the sites under investigation. 1 cm^3 slices of sediment were extracted from each core at 4 cm intervals, dried and placed in a furnace at 550°C for three hours. The amount of organic material incorporated in the sediment was calculated by measuring the weight loss from the sediment after burning. Burning results in the oxidation of organic matter producing CO_2 and H_2O. Variations in the percentage of organic material allow the detection of mineral inwash horizons invisible to the naked eye. For details of this procedure refer to Volume Two Appendix One. Results are presented in Chapters five to seven and in tabular form in Volume Two Appendix Two.

2:3:4 - Measurement of pH.

Measurements of pH were undertaken at 8 cm intervals on material from each site. 20 g of air-dry sediment was analysed using the elecrometric method, which measured the electrical potential (in terms of hydrogen ions) of each sample via reference and sensing electrodes. The pH values provided a guide to the chemical status of the samples based on a standard pH scale. For details of this procedure please refer to Volume Two Appendix One. Results are presented in Chapters five to seven and in tabular form in Volume Two Appendix Two.

2:3:5 - X-radiographs.

X-radiography is a non-destructive method of locating structures and changes in sediment density invisible to the naked eye (Hamblin 1962, Butler 1992). X-radiographs were only carried out on cores recovered from Cruvie, owing to limitations of time and resources. X-radiographs were undertaken at The British Geological Survey Edinburgh, using a SCANRAY 120L machine and standard medical X-ray film. For details of this procedure refer to Volume Two Appendix One. Examples of X-radiographs from Cruvie are presented in figures X-radiographs 1 and 2 (Chapter five).

2:3:6 - Preparation of tephrochronological samples.

At each of the sites investigated an entire core was allocated for the extraction of tephra, each core being sectioned into contiguous 4 cm blocks, producing a total of 218 samples. The samples were processed using the acid digestion technique (Dugmore *et al.* 1992). Following processing the presence / absence of tephra was determined by the examination of each sample (in a water suspension) using a standard petrographic microscope. Once the presence of tephra is established its source is determined by electron probe micro-analysis of individual volcanic shards.

The absence of tephra in the 218 samples examined (results are presented in Volume Two Appendix Two) prevented election probe micro-analysis of tephra from sites investigated during this study. However, training in tephra analysis was completed using tephra samples from other Scottish sites. For details of this procedure please refer to Volume Two Appendix One.

2:3:7 - Preparation of samples for radiocarbon dating.

A total of 18 radiocarbon dates was obtained during the course of this study. Radiocarbon dating of samples was undertaken at the Scottish Universities Research and Reactor Centre (S.U.R.R.C.), East Kilbride, under the direction of Dr G. Cook. Dates were obtained on samples of 4 cm thickness from Cruvie (5 dates) and 2 cm thickness from Pitbladdo (8 dates) and Methvern (5 dates). The humin and humic acid fraction were combined and formed the basis of the dates. All radiocarbon dates are expressed in the text in uncalibrated years BP (before 1950 AD). Pretreatments were undertaken by the author at East Kilbride and the methodology follows that of Shore (Shore *et al.* 1995). For details of this procedure refer to Volume Two Appendix One. Results are presented in Chapters five to seven.

2:3:7:1 - Core correlation.

To provide sufficient material for tephra analysis, radiocarbon dating, sedimentary analysis and pollen analysis to be undertaken it was necessary to extract material from three sediment cores at each of the sites.

In order to ensure the highest possible degree of accuracy all cores were extracted from within a 1.5m area (as major changes in sediment / pollen deposition are less likely within a limited area). Cores were correlated on the basis of changes in stratigraphy and comparison of pollen representation.

Pollen processing was undertaken on samples at precisely the same depth in the cores being matched (three samples per one metre core) and counts of 100 grains of arboreal pollen undertaken, a five grain or fewer variation between cores was considered to indicate an acceptable match. No significant changes were recorded within the sampling areas and the cores were all successfully correlated using this procedure.

2:4 - Factors influencing the preservation and distribution of pollen.

Pollen grains are produced by a flowering plants as part of their reproductive cycle. In order to ensure successful pollination plants produce an excess of pollen and vast quantities enter the atmosphere each year. As the pollen settles it becomes incorporated into the sedimentary environment with other decaying organic matter or sediment. Palaeopalynology is based upon the analysis of pollen retrieved from the sedimentary record.

"Pollen grains and spores are, by far and away, the most abundant Quaternary fossils, with the result that pollen analysis is the dominant technique in terrestrial Quaternary palaeoecology" Birks *et al.* (1988 p. 179).

The amount of pollen produced by individual taxa is determined primarily by the method of dispersal employed. Plants reliant upon unpredictable wind pollination produce more pollen than insect-pollinated plants, which are able to target their pollen more efficiently (Moore *et al.* 1991 p.181). Self-pollinating plants produce very limited amounts of pollen.

Differences in pollen productivity inevitably result in the differential representation of pollen taxa within the pollen record. A few workers (e.g. Andersen 1970, Bradshaw 1981) have attempted to calculate correction factors for pollen deposition beneath woodland canopies. These correction factors were not employed during this study as environmental conditions at the study sites and those used by such researchers as Andersen (1970) were not comparable throughout the Holocene, owing to variations in the degree of woodland cover at the sites under investigation.

Pollen grains are comprised of two layers, an inner cellulose layer and an outer exine layer comprised of sporopollenin (Zetzsche 1932). The value of pollen as a means of investigating the palaeoenvironmental record is based upon the exine layer's resistance to decay:

"the chemistry of the coat renders them resistant to decay and wherever microbial activity is depressed, whether due to wetness, salinity, low oxygen availability or drought, there is a chance of pollen and spore survival." Moore *et al.* 1991 p. 2.

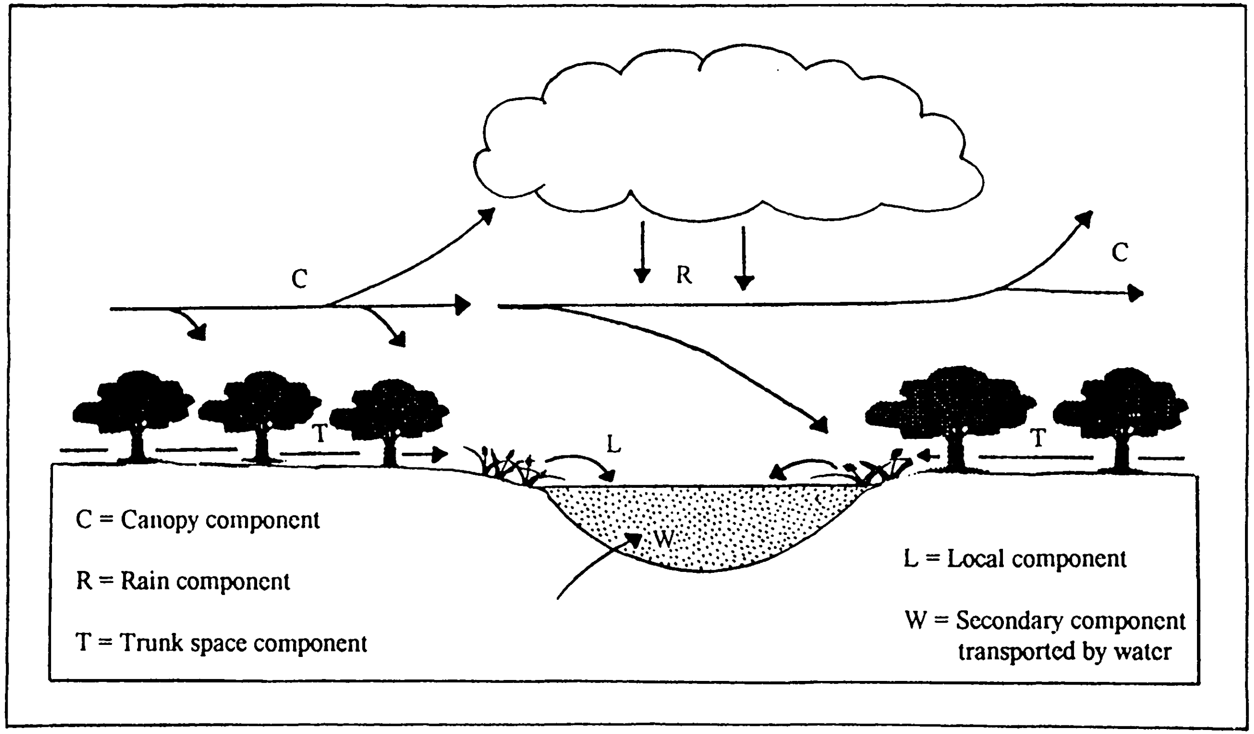
A second factor is the distinctive sculpturing of the exine which considered with the number of apertures, shape and size of the grain, combines to give each taxon a unique morphology.

The successful interpretation of a pollen assemblage is based upon an awareness of pollen sources. The sources of pollen input at a site are in part determined by the nature of the surrounding environment and in part by the size of the site. Tauber (1965) detailed the main mechanisms by which pollen can arrive at a site in a forested environment, the accumulating pollen comprising three major components (figure 22)

1) <u>Trunk space component</u> - Pollen falling from the canopy and produced by plants beneath the canopy, the majority of which is transported by subcanopy air movements.

2) <u>Canopy component</u> - Pollen from within or below the canopy which is carried by air currents above the canopy. Pollen from this component may be transported by air currents for considerable distances before deposition.

Figure 22 Sources of pollen in a small lake or mire within a wooded environment



After: Tauber 1965

3) Rain component - Pollen grains may form the nuclei of rain droplets or be collected on the surface of droplets during rainfall. The majority of pollen may be removed from the atmosphere in this way.

Pollen may also be incorporated from aquatic or bog species growing immediately upon the site (the local - Moore and Webb 1978 or gravity component - Jacobson and Bradshaw 1981) and from the remobilisation of pollen deposited away from the site (the secondary or inwashed component - Moore *et al.* 1991).

Jacobson and Bradshaw (1981) produced a model that indicated the relationship between the diameter of a site and the sources of the pollen (within a wooded environment). They identified three sources:

1) Local - comprising of pollen from the local component, the secondary component and the trunk space component.

2) Extra-local - comprising of pollen from the trunk space component, the secondary component and the canopy component.

3) Regional - comprising of pollen from the rain component and the canopy component.

The model suggests that the size of a site will determine the proportion of the pollen it receives from local, extra-local and regional sources, with local pollen input decreasing and regional pollen input increasing in an exponential manner in relation to increases in site size. A small site in a wooded environment will receive the majority of its pollen input from local sources, whilst larger sites will receive a greater input from regional sources.

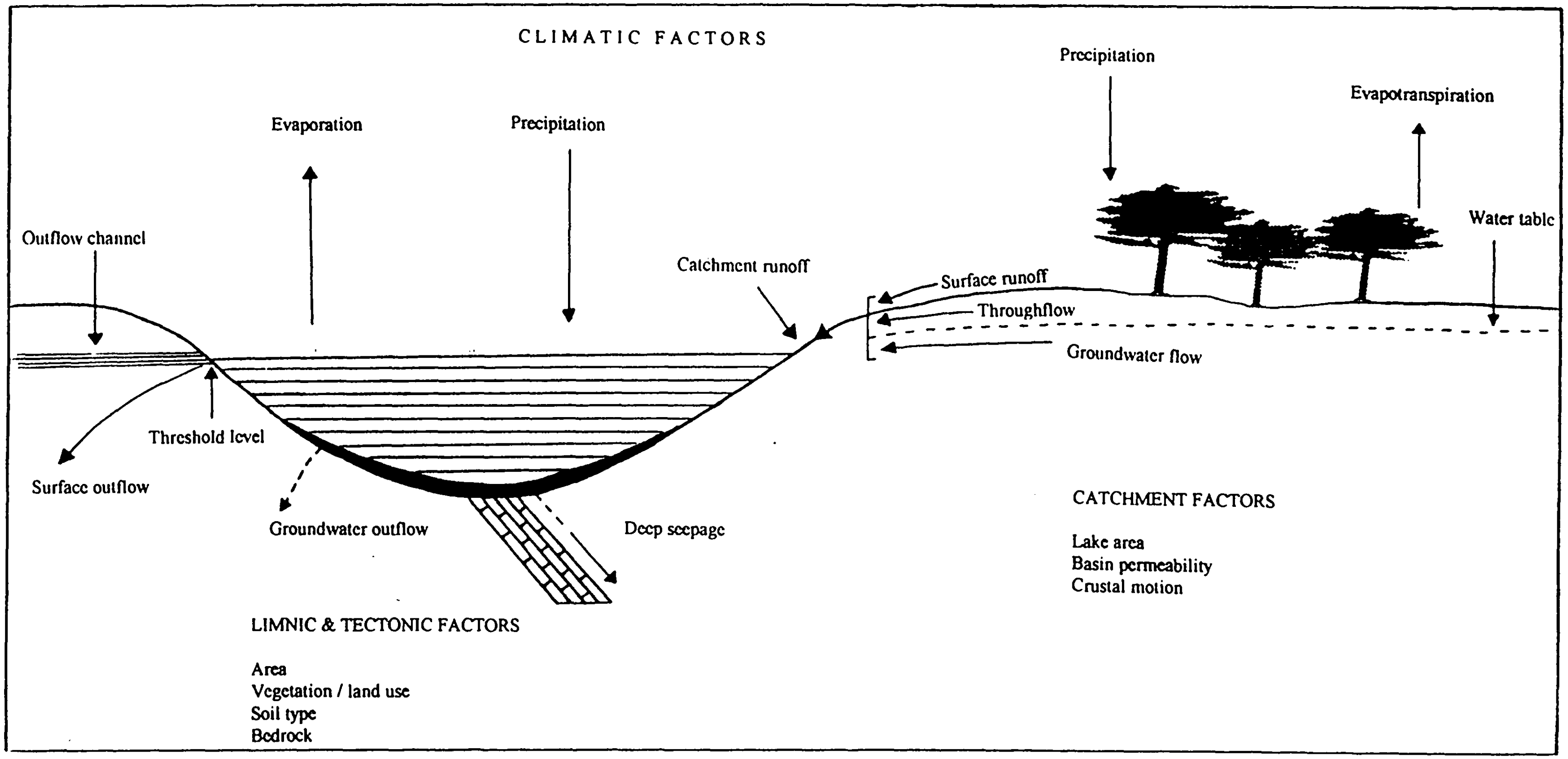
Work by Tinsley and Smith (1974) and Caseldine (1981) indicates that the majority of local pollen will be deposited within 30 m of the woodland edge, suggesting that cores from the central areas of larger sites will contain pollen largely derived from extra-local or regional sources.

These models form a useful basis for the interpretation of pollen data. However, the work outlined above is based upon the assumption of a forested environment and the researcher must consider that pollen input characteristics may alter radically over time, as vegetation compositions on and around the site change in response to natural or human modification.

2:5 - Factors influencing hydrological conditions.

Figure 23 shows the major factors that may operate in determining lake levels. Several of these factors, including crustal motion, bedrock and associated basin permeability are considered unlikely to have altered significantly at any of the study sites during the Holocene. However, changes in vegetation / landuse and the resultant impact on surface runoff may have had a significant effect upon water levels at both Cruvie and Pitbladdo.

Figure 23 Major factors governing lake levels and pathways of water movements.



After: J.A. Dearing and I.D.L. Foster 1986

Results presented in Chapter Five and Six indicate that areas of standing water were present at both Cruvie and Pitbladdo at intervals during the Holocene. In Chapter Eight a consideration of variations in the representation of aquatic taxa and the possible implications of these changes in relation to both climate factors across the study area and catchment based changes in vegetation / landuse (linked to surface runoff) is undertaken.

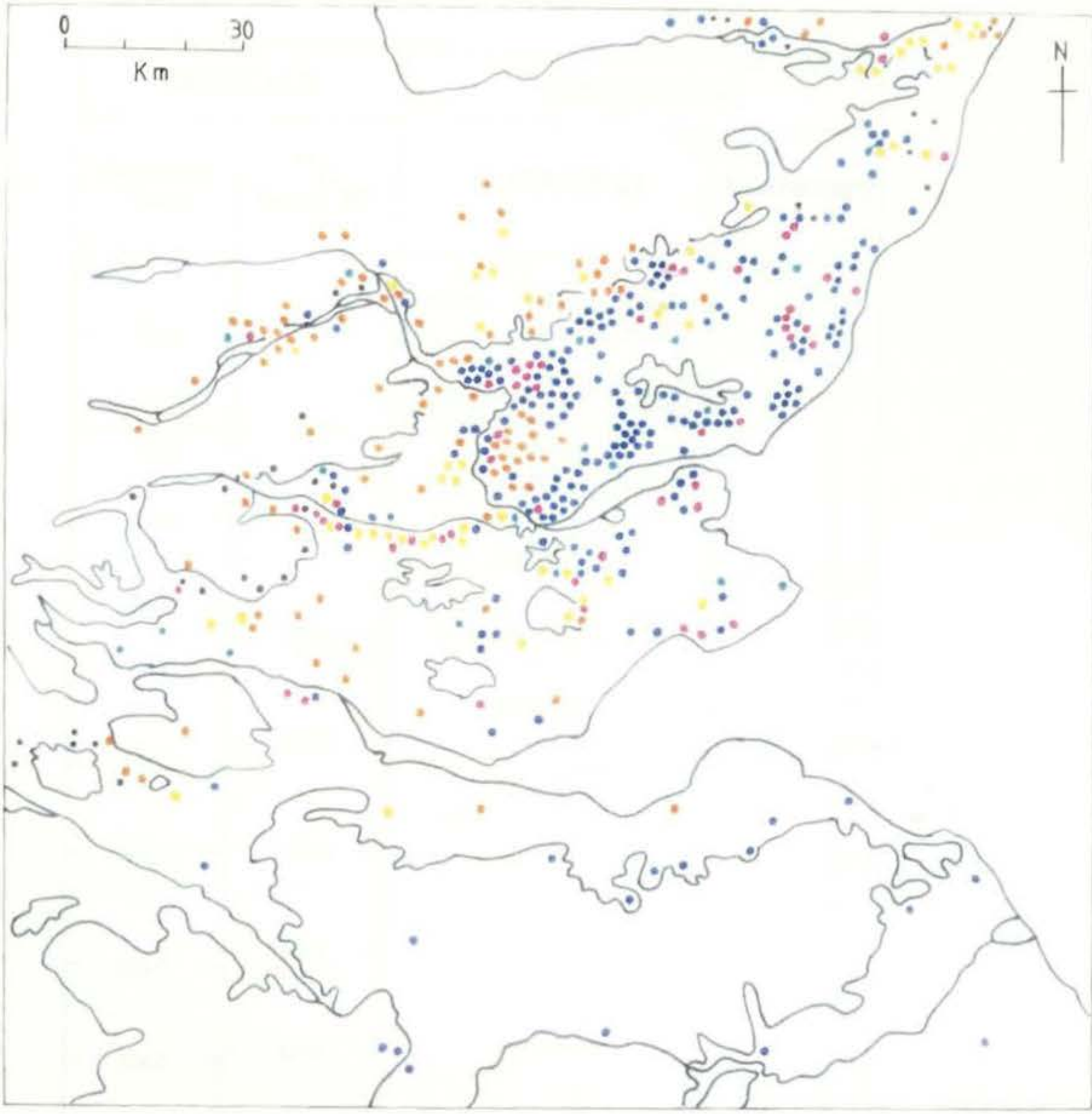
Chapter Three - Archaeological evidence for human activity within the study area.

3: 1 - Introduction.

The study area is located in a part of Scotland that in comparison to much of highland and western areas of the country is agriculturally rich and now supports a dense population. It is suggested that the favourable climate and high quality land would also have appealed to prehistoric populations, both those which may have lived primarily on gathered and hunted resources as well as cultivators and stockmen.

Eastern Scotland is rich in archaeological remains, comprising both landscape palimpsests as evident in recent RCAHMS survey in both upland and lowland Perthshire (RCAHMS 1990, 1994). To date the Royal Commission on the Ancient and. Historical Monuments of Scotland (RCAHMS) has identified over 75 000 archaeological sites in Scotland. These range from Neolithic funerary and ritual monuments of considerable complexity (for example the Balfarg monuments, Glenrothes: the Cleaven Dyke and Littleour near Meikleour), through all subsequent periods to Medieval moated sites Figure 24 shows the distribution of the main types of archaeological sites in lowland eastern Scotland. The chronological ranges for the archaeological and environmental subdivisions used during this report are shown in table 7. This chapter places the palaeoenvironmental sites under investigation within their archaeological context through a consideration of the number, range and possible age of the archaeological sites identified in the local area, defined as a block measuring 5km by 5km (25 sq km), surrounding each site. No attempt is made to review the wider archaeological literature, nor the literature in which the interplay between cultural and environmental factors in prehistory is considered, and the interested reader is referred to the reviews presented in Mitchell (1976), Megaw and Simpson (1979) and Simmons and Tooley (1981). For the periods primarily considered here, the Mesolithic and Neolithic, recent overviews of the Scottish record are provided by Wickham-Jones (1994) and in papers in a volume edited by Pollard and Morrison (1996); the most recent general synthesis on the Neolithic and Bronze Ages is that of Ashmore (1996). As this thesis was completed, a collection of papers edited by Edwards and Ralston (1997) appeared, in which environmental and archaeological issues are inter-related.

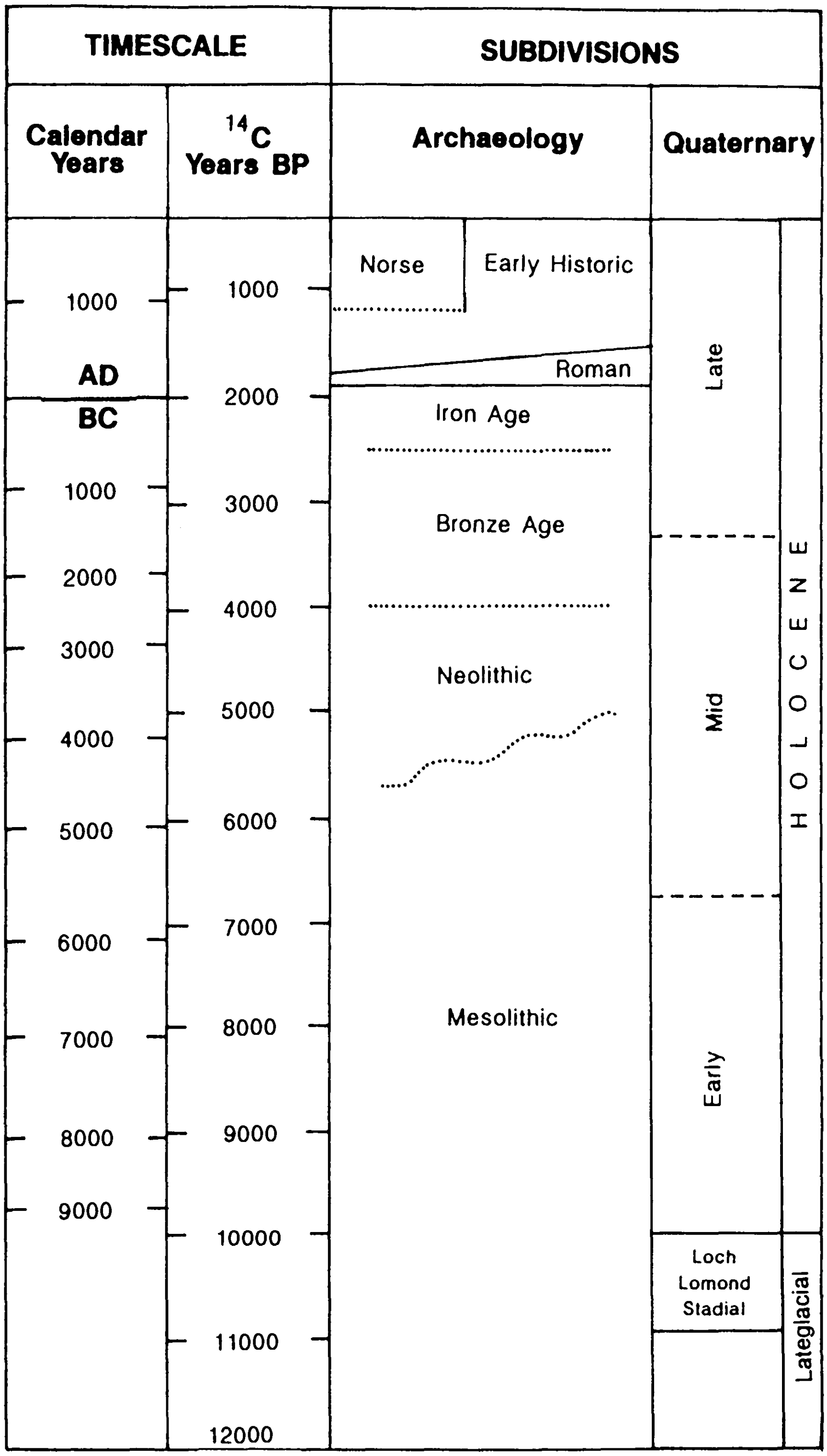
The identification and distribution of archaeological remains in the modern landscape is significantly influenced by patterns of survival as "modern field survey can only discover sites and monuments in so far as the history of land-use has allowed them to survive" RCAHMS (1994 p.7). The landscapes of eastern Scotland include tracts which may be considered in archaeological terms as zones of likely survival, where certain monument categories, notably those comprising durable materials, may still survive as three-dimensional features in the present-day countryside; these are interspersed, particularly in the lowlands, with extensive areas where arable agriculture and other activities have erased surface remains, such that the evidence of former utilisation in terms of archaeological sites is represented by cropmark records identified during aerial survey. Furthermore, Figure **24** Archaeological sites and monuments in eastern Scotland.



After: NMRS 1994.

•	Neolithic funerary monuments	33
•	Cursus monuments, recticular enclosures and pit-defined enclosures.	52
•	Henges, ring cairns, pit circles and recumbent stone circles.	60
•	Stone settings.	109
•	Souterrains and souterrain-like cropmarks.	226
•	Moated sites.	27
~	150m contour	

Table 7 A chronological guide showing archaeological and environmental subdivisions.



After Edwards and Ralston (1997).

the interpretation of the available remains is also problematic as "data sets frequently involve a broken time series; material under study is often qualitatively deficient; and it is practically impossible to know how deficient data sets are" Whittington and Edwards (1994 p.56). In both survey and excavation terms, the landscapes considered have not in general been subject to intensive archaeological work (either survey or excavation) in recent decades, as a result the available evidence is in many ways partial.

Archaeological evidence can be divided into three broad categories, each of which provides a different type and level of information:

i) Isolated finds which indicate the presence of activity (ranging from deliberate deposition to casual loss) within a landscape.

ii) Excavated archaeological sites. These sites, particularly if appropriately excavated in recent decades, provide the most detailed information and may be used to help in the interpretation of patterns of landuse and palaeoeconomy.

iii) Unexcavated archaeological sites. These sites are primarily represented by cropmarks. Cropmark sites identify the use of a landscape by humans; however they are defined mainly by comparison to other sites and their functions and age are generally unknown, except by analogy with excavated examples further afield, a process which is not without its problems.

The number, type and distribution of the archaeological remains identified in the areas surrounding each of the study sites are shown in tables 7 to 10 and figures 25 to 27. The number and range of remains identified indicate that the local area surrounding each of the sites has been subject to human activity over a considerable period of time. The following sections consider the types of archaeological remains identified at each locale and the possible implications for human activity.

3:2 - Archaeological remains at Cruvie.

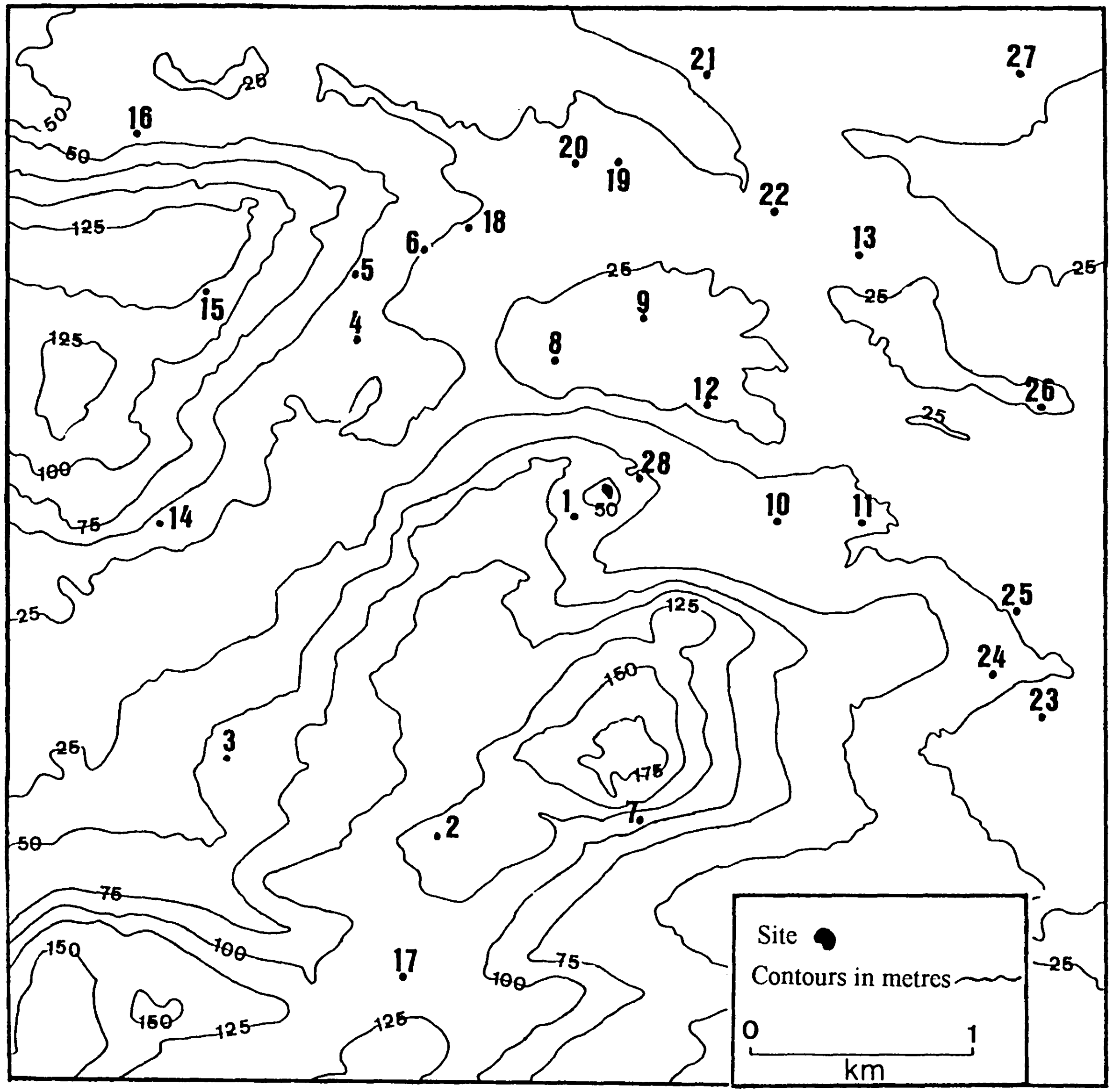
Table 8 and figure 25 show that archaeological remains have been identified at 28 locations in the area surrounding Cruvie. No Mesolithic or Neolithic finds are recorded in the vicinity of this site. The presence of a burial cairn, cists and the excavation of a settlement complex carried out at North Straiton (site numbers 8, 9 and 12 - table 26) which "proved that settlement had existed in the Early and Later Bronze Ages and in the pre-Roman Iron Age" Driscoll, S. and Watkins, T. (1989 p.24) are considered to indicate the presence of a human population in this area during the Bronze Age and extending into the later prehistoric period. The presence of a range of settlement and crop-mark features in the area surrounding Cruvie is considered to reflect activity during this same period, although an assessment of the timing of this activity remains problematic (see 3:5). The remains of a late 15th or 16th century castle (site number 28) is considered to reflect the presence of a considerable local population in the area immediately adjacent to the site.

Table 8 Archaeological sites in the local area surrounding Cruvie.

Number	Location	Grid reference	Description
1	South Straiton	416/227	Site - Ring-ditches 2 (possible).
2	Ardlogie House	4099/2119	Site - Remains of a conical cairn 100 feet in diameter, 2 urns, 3 cists.
3	Brighouse Farm	4000/2160	Chance find - Blue glass bead, 2.4cm diameter, 1.6cm height.
4	Easter Kinnear	4060/2350	Various - Ring-ditches, settlement (unenclosed).
5	Hawkhill	4060/2380	Settlement (unenclosed).
6	Hawkhill	4090/2390	Linear cropmarks.
7	Lucklaw Hill	4190/2130	Site - Cremations (possible), two prehistoric pots.
8	North Straiton	4150/2340	Settlement (unenclosed).
9	North Straiton	4190/2360	Various - Pit alignment, cropmarks.
10	Brackmont	4250/2270	Enclosure.
11	Brackmont	4290/2270	Enclosure.
12	North Straiton	4220/2320	Settlement (unenclosed) - Four cropmark settlement sites.
13	Crawley Hill	4290/2390	Cropmarks - Ring-ditch, linear cropmarks.
14	Kilmany	3973/2265	Ring-ditch; enclosure.
15	Newton Hill	3990/2370	Cropmark (linear).
16	Newton Hill	396/244	Enclosure (possible).
17	Logie House	4080/2060	Site - Cairns; urn.
18	Hawkhill	4110/2400	Site - Settlement (unenclosed), linear cropmarks.
19	Boulterhall	4180/2430	Site - Pit alignment, cropmarks.
20	Boulterhall	4169/2446	Remains of a burial place, roughly enclosed by a dike.
21	Morendy Wood	4220/2470	Various - Barrow, square, enclosure, linear cropmarks.
22	Crawley Hill	4250/2410	Enclosure.
23	Southfield	4370/2180	Various - Settlement, unenclosed (possible), linear features.
24	Brackmont Hill	4350/2200	Cropmark complex.
25	Brackmont Hill	4360/2230	Site - Cremation cemetary. Large number of urn burials and cremations
26	Strathburn	4370/2320	Various - Linear cropmarks, cultivation remains.
27	Pickletillem	4360/2470	Chance find - Polished Flint Axe.
28	Cruvie	419/229	Site - Remains of late 15th or early 16th century castle.

Based on data held by The Royal Commision on the Ancient
and Historical Monuments of Scotland.

Figure 25 Archaeological sites in the local area surrounding Cruvie



3:3 - Archaeological remains at Pitbladdo.

Table 9 and figure 26 show that archaeological remains have been identified at 18 locations in the area surrounding Pitbladdo. No Mesolithic finds are recorded in the vicinity of this site. The presence of stone axes and arrowheads is considered to reflect a Neolithic presence as "stone axes, and perhaps leaf-shaped arrowheads, are the most durable and readily recognisable parts of the Neolithic tool-kit." RCAHMS (1994 p.38). However, it is recognised that "stone axes together with other types of stone implements almost certainly remained in use from the fifth until at least the second millennium BC" RCAHMS (1994 p.38). The presence of cairns, cists and a bronze spearhead, dated to 1000 to 800 BC, is considered to indicate human activity during the Bronze Age, whilst the presence of a souterrain and a range of other crop-mark features suggests human settlement during the Iron Age and into the early historic period of the first millennium Ads (see 3:5). The remains of Lordscairnie Castle (site number 18) again may be taken to reflect the presence of a considerable local population during the Medieval period.

3:4 - Archaeological remains at Methvern.

Table 10 and figure 27 show that archaeological remains have been identified at 30 locations in the area surrounding Methvern. No unequivocal evidence for human activity during the Mesolithic is recorded at this site. However, the presence of a flint scraper (site number 18) of possible Mesolithic age suggests humans may have been active in this area during the Mesolithic period. The presence of a stone circle and the recovery of a number of stone tools, including stone axes, an axe-hammer and arrowheads are considered to reflect the presence of humans during the Neolithic period, whilst the recovery of a socketed bronze spearhead suggests Late Bronze Age activity. The recognition of enclosures, rig-and-furrow cultivation, a range of crop-marks and a fort at Meckphen (site number 25) all suggest that humans were active in the vicinity of this site during the Iron Age, the early historic period and, in the case of rig-and-furrow, the present millennium (see 3:5).

3:5 - Chronology and context.

The evidence for and interpretation of prehistoric settlement is based upon the survival and chance discovery of remains within the modern landscape as well as the recovery of datable material from the excavated sites. Interpretation is hindered owing to the limited number of excavations undertaken and the difficulties associated with the identification and classification of sites based upon crop-mark or other evidence prior to excavation. For example, a crop-mark complex at Craigie Hill, North East Fife, was initially identified, prior to excavation as

"a small ditched enclosure about 10 m across associated with an amorphous, dark, circular feature which might be interpreted as a house with a sunken floor" Watkins and Freeman (1991 p. 31).

Table 9 Archaeological sites in the local area surrounding Pitbladdo

Number	Locations	Grid reference	Descriptions
1	Lordscairnie	350/179	Chance find - Bronze spearhead, date of 1000 to 800 BC.
2	Myrecairnie	365/179	Cropmarks - Enclosure.
3	East Hall	346/166	Enclosure.
4	Moonzie Farm	341/177	Site - Cists, several stone coffins found during ditching.
5	Pittencreiff	3714/1601	Cropmarks - Enclosure (possible).
6	Myrecairnie Hill	370/182	Site - Fragments of a very small urn.
7	Muirside	339/170	Cropmarks.
8	Luthrie Bank	33/19	Chance find - Stone Axe, 70mm long.
9	Luthrie	3363/1950	Cropmarks - Enclosure.
10	East Hall	342/157	Cropmarks - Settlement (unenclosed), souterrains.
11	Wester Balgarvie	347/158	Cropmarks - Settlement (unenclosed), souterrains.
12	Kinloss House	365/157	Chance find - Stone Pestle.
13	Middlefield	380/155	Site - Cairns, Cinerary Urns, Polished Stone Axes.
14	Foxton	3886/1619	Cropmarks - Ring-ditch.
15	Foodie	3831/1717	Cropmarks - Enclosure.
16	Foodie Hall	3843/1736	Cropmarks - Enclosure.
17	Kedlock	382/191	Chance find - Arrowheads.
18	Lordscairnie	348/171	Site - Remains of Lordscairnie Castle.

Based on data held by The Royal Commision on the Ancient and Historical Monuments of Scotland.

Figure 26 Archaeological sites in the local area surrounding Pitbladdo.

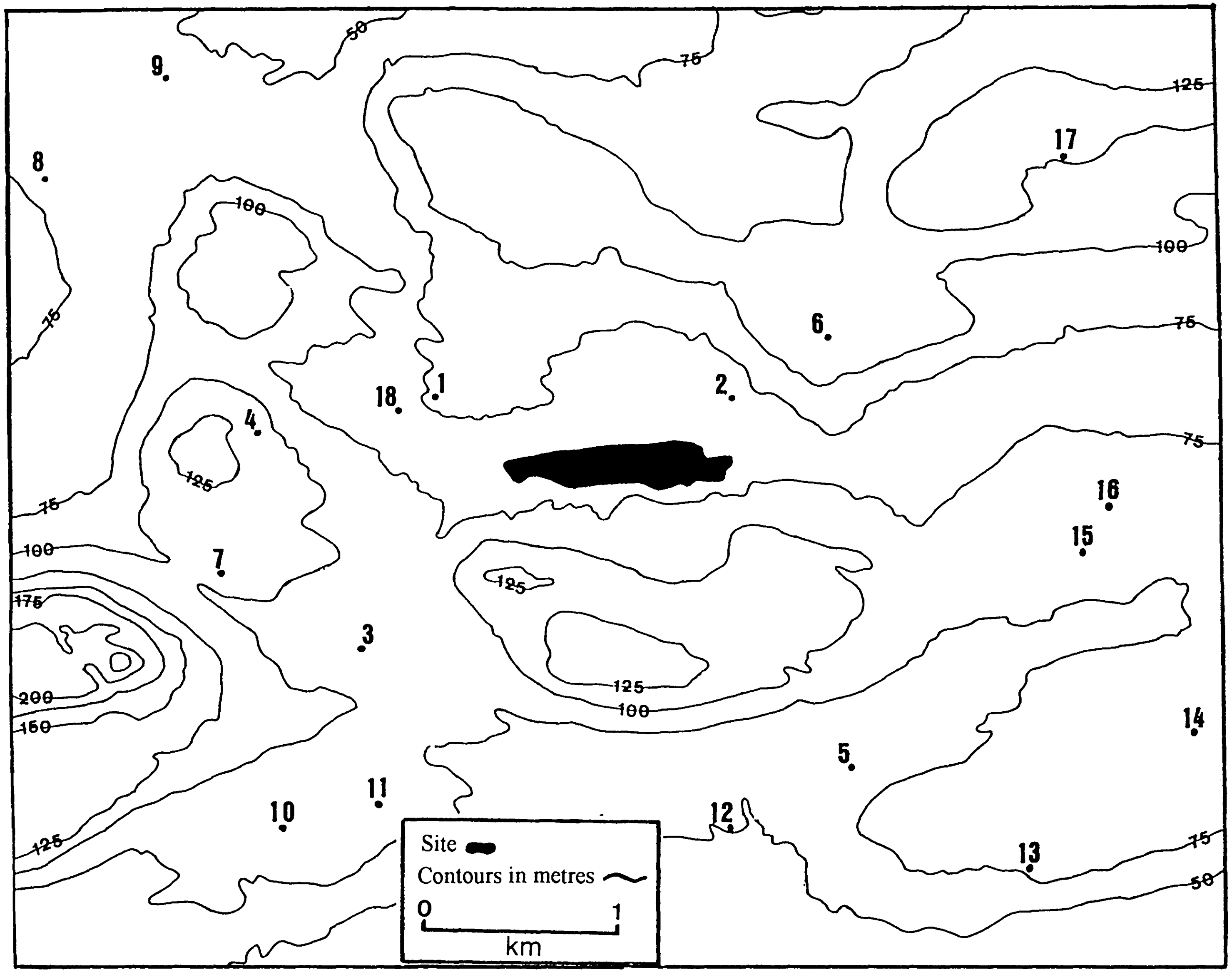
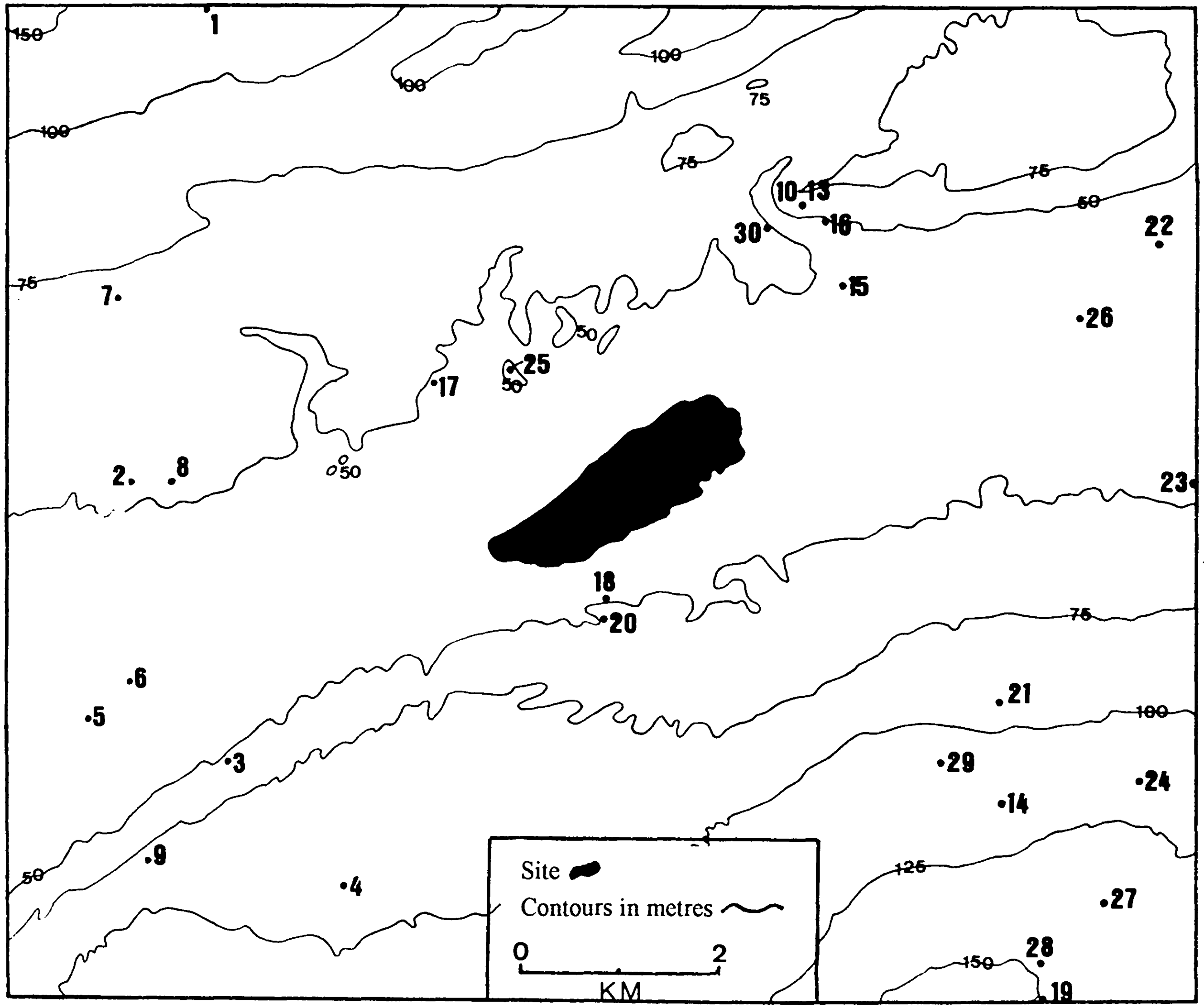


Table 10 Archaeological sites in the local area surrounding Methvern.

Number	Location	Grid reference	Description
1	North Cassochie	NN 99/26	Chance find - Stone Axe.
2	Balgowan	NN 986/236	Chance find - Stone Axe.
3	Ross	NN 991/222	Site - Pit - Alignment (Possible).
4	Westmuir Wood	NN 997/216	Indeterminate Remains.
5	Redhills	NN 984/224	Cropmarks.
6	Redhills	NN 986/226	Site - Enclosure, Pits (Possible).
7	North Lodge	NN 9855/2451	Enclosure.
8	Balgowan House	NN 988/236	Rig-and-furrow cultivation.
9	Ross	NN 987/217	Rig-and-furrow cultivation.
10	Methvern	NO 02/25	Chance find - Socketed Bronze Spearhead
11	Methvern	NO 02/25	Chance find - Stone Axe.
12	Methvern	NO 02/25	Chance find - Stone Axe.
13	Methvern	NO 02/25	Chance find - Axe-Hammer.
14	Cultmalundie	NO 03/22	Various - Bronze Fibula, Whorl, Flints.
15	Tippermallo	NO 022/246	Site - Cist, Beaker, Flint Scraper, Knife.
16	Methvern	NO 021/249	Chance find - Flint Arrowhead.
17	Bachilton	NO 0015/2411	Site - Mound; Stone Circle.
18	Methvern Moss	NO 01/23	Chance find - Flint Scraper.
19	Westmuir	NO 032/210	Linear crop-marks.
20	Newmiln	NO 010/229	Chance find - Stone Hammer.
21	Wester Cultmalundie	NO 0300/2235	Crop-mark - Enclosure.
22	Kinnon Park	NO 038/248	Enclosure.
23	Mains of Cultmalundie	NO 040/236	Cropmarks.
24	Wester Cultmalundie	NO 037/221	Chance find - Flint Arrowhead.
25	Meckphen	NO 0056/2415	Site - Fort.
26	Mains of Tippermallo	NO 034/244	Various - Pits, Cultivation Remains, Settlement Unenclosed (possible), Cropmarks.
27	Cultmalundie Woods	NO 0351/2152	Rig-and-furrow cultivation.
28	Cultmalundie Woods	NO 0321/2121	Rig-and-furrow cultivation.
29	Westmuir	NO 027/222	Rig-and-furrow cultivation.
30	Burnside	NO 0186/2491	Rig-and-furrow cultivation.

Based on data held by The Royal Commision on the Ancient and Historical Monuments of Scotland.

Figure 27 Archaeological sites in the local area surrounding Methvern.



However, excavation of this site revealed that "no traces of the features which caused the crop-mark could be found" Watkins and Freeman (1991 p.31). This result highlights the difficulties associated with the identification of sites prior to excavation. In addition, the excavation of a site may not result in the recovery of datable material and identifications may have been based on comparative evidence from similar sites which have been successfully dated. Owing to these difficulties, "the chronology of the various types of settlement remains that have been described is far from clear" RCAHMS (1994 p.70), in the case of the most recently and intensively surveyed portion of lowland Perthshire.

On the basis of the available data it is suggested that there is little evidence of human activity relating to the Mesolithic period in the vicinity of the sites under investigation. However, the presence of a Mesolithic settlement (Morton) within the study area (approximately 7 km from the nearest palaeoenvironmental site at Cruvie and 48 km from the most distant site at Methvern) indicates that humans were active in this area of Scotland during the Mesolithic period. The site at Morton contains an abundance of lithic material, floral and faunal remains and charcoal, for which a range of isotopic determinations including one of 8050 +/- 250 BP (Coles 1971, 1983), have been obtained. This represents one of the few Mesolithic sites excavated, to modern standards, in eastern lowland Scotland, and the partiality of the evidence - even compared to that for other eastern river valleys, such as the Aberdeenshire Dee (Kenney 1993) and Tweed (Mulholland 1970), may be seen rather as an indication of the absence of field survey targeted on the recovery of flint debris, as evidence of the absence of hunter-gatherer communities in these areas. Other Scottish sites relating to the early Mesolithic period include Redkirk Point, Dumfriesshire, which has been dated to 8000 +/- 65 BP (Masters 1981) and Farm Fields, Kinloch Rhum, which has been dated to 8590 +/- 95 BP (Wickham-Jones 1990).

The presence of a range of stone tools in the locality of both Pitbladdo and Methvern, combined with the occurrence of carved stone balls (distribution in Marshall 1977) attributed to the later Neolithic within the general study area is considered to indicate the local presence of humans during the Neolithic period. The range of Neolithic monuments recorded elsewhere in eastern lowland Scotland (figure 24) suggests that humans were active throughout this area of Scotland, although the selective preservation of remains limits an accurate assessment of their distribution from presently available archaeological data (Barclay 1997). It is possible that some of the round cairns or barrows noted may be attributed to the Neolithic.

The presence of a number of cairns, cists and urns both in the vicinity of the sites and across the study area is considered to reflect activity during the Bronze Age as " the majority of the cists and urns probably belong to the Early Bronze Age" in the view of RCAHMS (1994 p.23). The recovery of three bronze swords of a type attributed to the early Iron Age Hallstatt culture (Burgess 1968) and the presence of hilltop enclosures, hut circles and a number of souterrains within the study area, along with the evidence contained in the cropmark record, is considered to reflect a strong presence during later prehistory and into the first millennium AD. However, it is recognised that a range of dates has been obtained from the limited number of excavated souterrains in eastern lowland Scotland. The earliest date obtained for a souterrain-like site at Dalladies in Kincardineshire falls approximately within the third century BC (Watkins 1981), whilst the recovery of fragments of Samian ware dating from the second century AD from the two souterrains at Pitcur (Barclay 1981) indicates that this type of site was not restricted to the Iron Age but formed a component of settlements over a considerable time period.

Evidence of the Roman incursions into Scotland during the Iron Age is based upon the presence of camps within the study area. The camps identified at Abernethy and Bonnytown are considered to represent activity during the Flavian Period, which culminated in about AD 79 under the command of Julius Agricola (Whittington and Edwards 1993). The camps identified at Cupar, Auchtermuchty and possibly Auchterderran are considered to reflect activity during the third incursion (the Severan Period) between AD 208 and 211 (Whittington and Edwards 1993). Other evidence of Roman activity includes the presence of temporary camps at Forteviot and Dunning, a road and signal stations along the Gask Ridge (RCAHMS 1994) and most importantly the extensive Flavian Fortress at Inchtuthil (Pitts and St Joseph 1985). Whittington and Edwards (1993) propose that the Roman incursions may have impacted on the local populations of eastern Scotland to the extent that this process is visible in forest regeneration, but others (for example Hanson 1997) have disputed this view.

A consideration of place-names and symbol stones undertaken by Whittington (1977) suggests that Fife was an important area for Pictish settlement during the Dark Age period, whilst Driscoll's doctorate has drawn attention to the possible development of substantial estates there during the later first millennium AD (Driscoll 1991). The presence of moated sites and castles within the study area, in particular Lordscairnie Castle located close to Pitbladdo and Cruvie Castle located close to the palaeoenvironmental site at Cruvie, are considered to reflect human occupancy extending into the Medieval period.

The evidence outlined above indicates the range of archaeological remains that have been identified to date within the study area and has shown that humans have been active in this region throughout the prehistoric and historic periods. However, the evidence also highlights the degree of uncertainty that exists in the interpretation of many of the archaeological remains encountered. Palaeoenvironmental investigations provide a record of land-use change and human activity for which there may remain only limited archaeological evidence, and the approach can represent an important interpretational tool that should be used in association with the traditional archaeological methods.

It is considered that palaeoenvironmental investigations may have a particularly important role to play in areas of intensive modern settlement and cultivation, where significant amounts of the archaeological record may have been destroyed.

Chapter 4 Tephrochronology

4:1 - Introduction

The discovery of a terrestrial tephra (volcanic ash) deposit at Altnabreac, Caithness (Dugmore 1989) marked the introduction of a new dating technique to the British Isles. Tephrochronology is a dating technique based on the identification, correlation and dating of tephra layers leading to the production of a chronology, which may be used to determine the age of associated materials (Thorarinsson 1944, 1974).

Tephra is a collective term for all airborne pyroclasts including volcanic ash (Thorarinsson 1974). In relation to tephrochronology volcanic ash is of primary importance. Ash produced by explosive volcanism can be rapidly dispersed and deposited over wide areas and long distances (Einarsson 1986), resulting in the formation of time-parallel markers or isochrones, which may be used to establish temporal links between sites across a range of distances with a degree of chronological precision not attainable using other dating techniques (Buckland *et al.* 1981).

Tephrochronological studies were first integrated with palaeoecological studies during the 1930s (Thorarinsson 1974) and have subsequently been undertaken in many areas including California (Andersen 1990), Columbia (Bakker and Salomons 1989), Japan (Sakaguchi and Katoh 1990) and Kenya (Findlater 1976). Although the majority of these studies has concentrated on tephra's value as an isochrone, research into the possible impact of volcanic events on both past vegetation and human activity has also been undertaken (e.g. Baillie 1989, Burgess 1989, Thordason and Self 1993, White and Humphreys 1994).

In recent years several studies have established the presence of extensive deposits of tephra in the area of north-west Europe both off-shore (Long *et al.* 1986, Long and Morton 1987) and on-shore (Persson 1966, 1971, Mangerud *et al.* 1984, 1986 Johansen 1985, Dugmore 1989, 1991, 1995, Bennett *et al.* 1992, Pilcher and Hall 1992, 1993, Merkt *et al.* 1993, Edwards *et al.* 1994, 1995), leading to an increased interest in the possibility of both establishing tephrochronology in the British Isles and applying the technique to practical issues of palaeoenvironmental reconstruction. These Holocene layers have all been formed by Icelandic eruptions. The only tephra layer in this area from a non-Icelandic source is the Laacher See Tephra formed ca. 11000 BP by an eruption in the Eifel Mountains in Germany, which spread not only to the south, but also into the Baltic region (Bogaard and Schminche 1985).

In Iceland distinct volcanic systems can be distinguished by their petrological, geographical and geochemical characteristics (Jacobson 1979). Long distance correlation may be achieved through geochemical analyses tested against the detailed stratigraphical records in proximal areas (Larsen 1981, 1982, Dugmore *et al.* 1995). The identification of individual volcanic events allows the production of a tephra stratigraphy, which increases the value of tephra's as a powerful tool in studies of environmental change (Thorarinsson 1981).

4:2 - The recognition of tephra in distal areas.

The identification of Holocene tephra in organic deposits in areas substantially distant from the source area, such as Britain, is not possible on the basis of macroscopic examination of the sediments. Owing to a combination of the scale of eruptions and wind directions, particle sizes of < 120 μm and mass loading of < 10 tonnes per hectare ensure that tephras deposited in Scottish peat bogs are invisible to the naked eye (Dugmore 1989, Dugmore and Newton 1992). In distal areas the volcanic origin of deposits of fine grained tephra can be identified on the basis of the optical characteristics and morphology of individual grains (Persson 1971), but more detailed correlation requires geochemical data (Westgate and Gordon 1981).

Work by Dugmore and Newton (1992) has established the value of X-radiography in revealing the position of thin layers of tephra in Scottish peat deposits. This method of location has the advantage of being both non-destructive and quick, as it eliminates the need to process entire peat cores in order to locate single tephra deposits. However, X-radiography is most efficient at locating discrete deposits where there exists a significant density difference between the tephra and the surrounding sediment matrix. At a test site in Caithness, Hekla 4 showed clearly, whereas the distinct but very sparse deposits of the Glen Garry Tephra did not (Dugmore and Newton 1992). Clearly there are practical limitations and this procedure is still being evaluated in terms of its ability to identify very sparse tephra horizons. At present the destructive analysis of contiguous samples of deposits remains the only comprehensive means of locating tephra within organic sediments.

The extraction of tephra from organic deposits involves the destruction of the organic fraction leaving a residue of inorganic material, of which, in layers corresponding to tephra events, 80 to 90 % can be tephra (Dugmore 1989). The residue is mounted on slides and examined for the presence of grains of volcanic ash using a petrological microscope. (For details of the methodology see Appendix One, Volume Two). With some samples, sieving is necessary to reduce the bulk of the sample (Long and Morton 1987, Long *et al.* 1986) Any tephra located then undergoes geochemical analysis (using electron probe micro-analysis) in order to determine its source.

During this study tephra analysis was undertaken at all three of the sites under investigation, a total of 218 samples. Conditions at all sites were ideal for the preservation of tephra and it was initially hoped that it would be possible to establish a tephrochronological framework across the study area, allowing chronologically precise correlations to be made between the sites. However, despite extensive investigation using both X-radiography (this method was undertaken at Cruvie only, owing to limited resources; for details see table 13 Appendix Two, Volume Two and Chapter 2:3:5) and destructive extraction techniques (tables 10 to 12 Appendix Two, Volume Two), no tephra was located at any of the sites investigated. Radiocarbon dating of the sites undertaken in response to the absence of tephra showed that samples analysed for tephra spanned the period of approximately 760 to 7500 BP, encompassing five of the seven tephras currently identified elsewhere in Scotland (Dugmore *et al.* 1995). The absence of the Hekla 4 Tephra (ca. 3800 BP) from the sites was of particular interest as this tephra has been located at every site examined in the Highlands, but is absent from a lowland location on Lewis (Edwards and Blackford, pers. com.). It is therefore considered that the absence of tephra at the study sites reflects the nature of tephra distribution and deposition in distal areas, rather than the absence of sediments of an appropriate age.

4:3 - Factors influencing distribution and deposition.

The distribution of tephra is determined by the size of the eruptive event, the distance of the study area from the source area, wind direction and possibly (in distal areas) rainfall patterns, whilst the deposition of tephra on the ground surface may be influenced by the nature of the vegetation cover and microtopography.

The size of volcanic events and the distance from source area, although representing limiting factors, are not considered to constitute critical limitations to tephrochronology in the British Isles. The source area for volcanic ash deposited in this area of Europe is Iceland, which is located approximately 800 km north-east of the British Isles (see figure 28). To date, 37 tephra sites have been located within Scotland and Ireland, 14 of which contain deposits that have been geochemically identified successfully (see figure 30). Tephras originating from Iceland have also been successfully identified in both Finland and Germany (Salmi 1948, Van den Bogaard *et al.* 1994) and throughout central Norway and Sweden (Persson 1971). It is therefore considered unlikely that the study area's position in terms of distance from the volcanic area accounts for the absence of tephra.

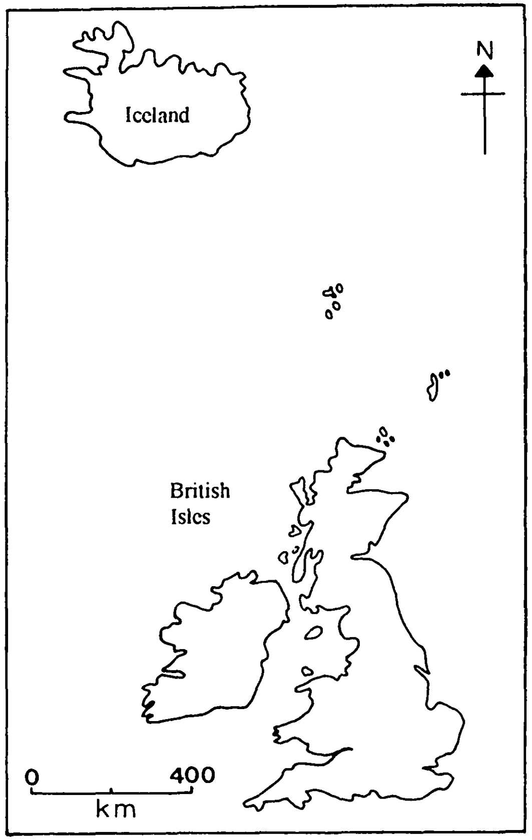
The influence that prevailing patterns of atmospheric circulation has on the transportation of tephra is not in doubt:

"the distribution of tephra will mainly be decided by the wind direction in the troposphere during the eruption" (Einarsson 1986 p. 330).

A consideration of the present-day prevailing wind directions (figure 29) suggests that eruptive clouds of ash are likely to approach northern Britain from a generally westerly or north-westerly direction. It is proposed that the prevailing wind direction determines fallout paths and that the distribution of tephra along these paths may be linked to the occurrence of rainfall.

The distribution of tephra from the Hekla eruption of 1947 appears to support this proposal. The fallout path for this event crossed both the British Isles and Denmark, but so far no trace of tephra deposits linked to this event have been located in these countries. However, ash was extensively deposited across southern Finland (Salmi 1948), with fallout occurring only in those

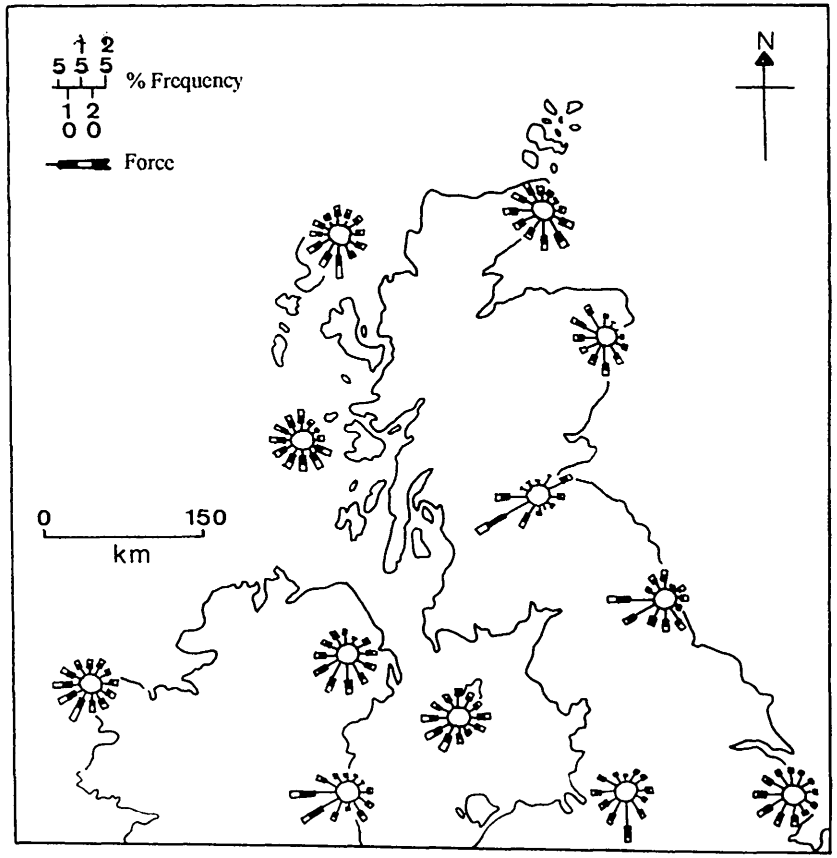
Figure 28 showing the position of Iceland in relation to the British Isles.



Source: Hall et al 1993.

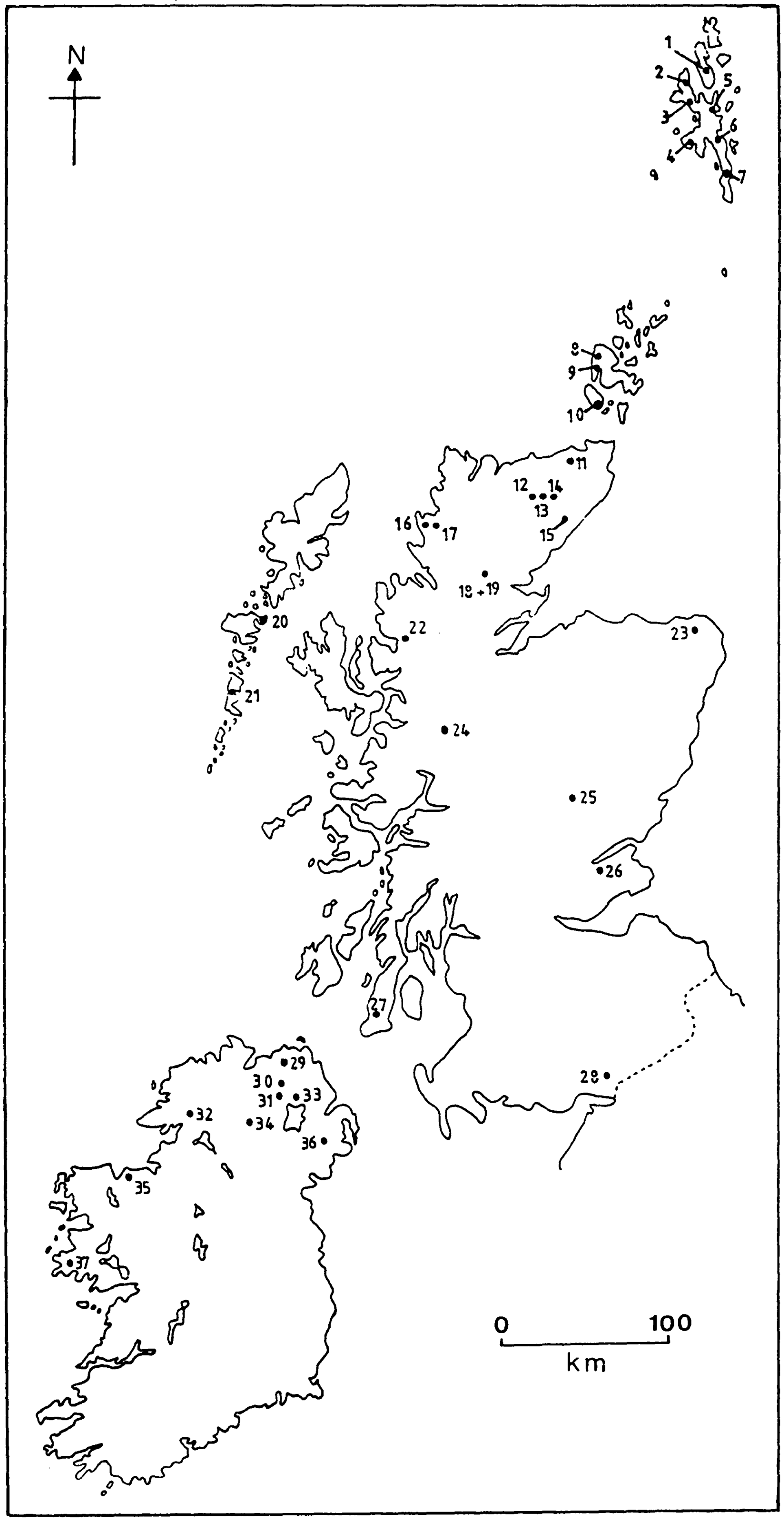
Figure 29 showing annual percentage frequency of the force (Beaufort scale) and direction of the wind.

(Source: Chandler and Gregory 1976, figure 3.1).



Source: Chandler & Gregory 1976.

Figure 30 showing the distribution of Scottish and Irish tephra sites.



Source: Hall et al 1994 Dugmore et al 1995, Edwards et al 1994

Table 11

Key to Figure 30 showing Scottish and Irish Tephra Sites.

Scottish Sites						Irish Sites		
Number		Site Name	Number		Site Name	Number		Site Name
1		Sandwater Hill	15	*	Glen Na Beiste	29		Garry Bog
2		Housetter	16		Clachtoll	30		Fallahogy Mire
3		Gunnister	17		Cnoc Poll nam Muc	31		Ballynahone Bog
4		Brunatwatt Peat	18	*	Lairg	32		Barnesmore Gap
5		Dallican Water	19		Achany Glen	33	*	Sluggan Bog
6	*	Kebister	20	*	Loch Portain	34		Fairywater Bog
7		Geosetter	21		Loch Hellisdale	35		Owenbeg
8		Quoyloos Meadow	22	*	Beinn Eighe	36	*	Lough Henney
9		Crudale Meadow	23	*	New Pitsligo	37		Connemara
10	*	Hoy	24	*	Glen Garry			
11		Loch Calder	25		Carn Dubh			
12	*	Slethill	26		Black Loch			
13	*	Loch Leer	27		Rhoin Farm			
14	*	Altnabreac Station Hill	28		St Bride's Moss			

* = Sites with geochemically identified tephra horizons.

areas experiencing rain and sleet as the eruption cloud passed the area (Salmi 1948, Thorarinsson 1967).

It is accepted that this example does not represent conclusive evidence that rainfall and tephra patterns are intrinsically linked in distal areas. However, if a degree of association is accepted it may be argued that the majority of tephra identified in Scotland will be located in the areas of highest rainfall (the west and north of Scotland) and in areas where high ground triggers rainfall (see figure 31), and that sites investigated in these areas will yield more comprehensive tephra records than areas of lower rainfall in eastern Scotland. It may also be argued that as the majority of deep peat deposits are located in the areas of highest rainfall (Ratcliffe and Oswald 1988), these areas provide the best opportunities for the preservation of any ash falls.

A final factor that may play an important role in determining the nature of the tephra record is the vegetation cover of the area onto which the tephra is deposited. An examination of open peat sections in Iceland during 1992 (by the author and Dr A. Dugmore) revealed that fine tephra horizons were often discontinuous in nature, an observation also noted by Einarsson (1986 p.331) who suggested that

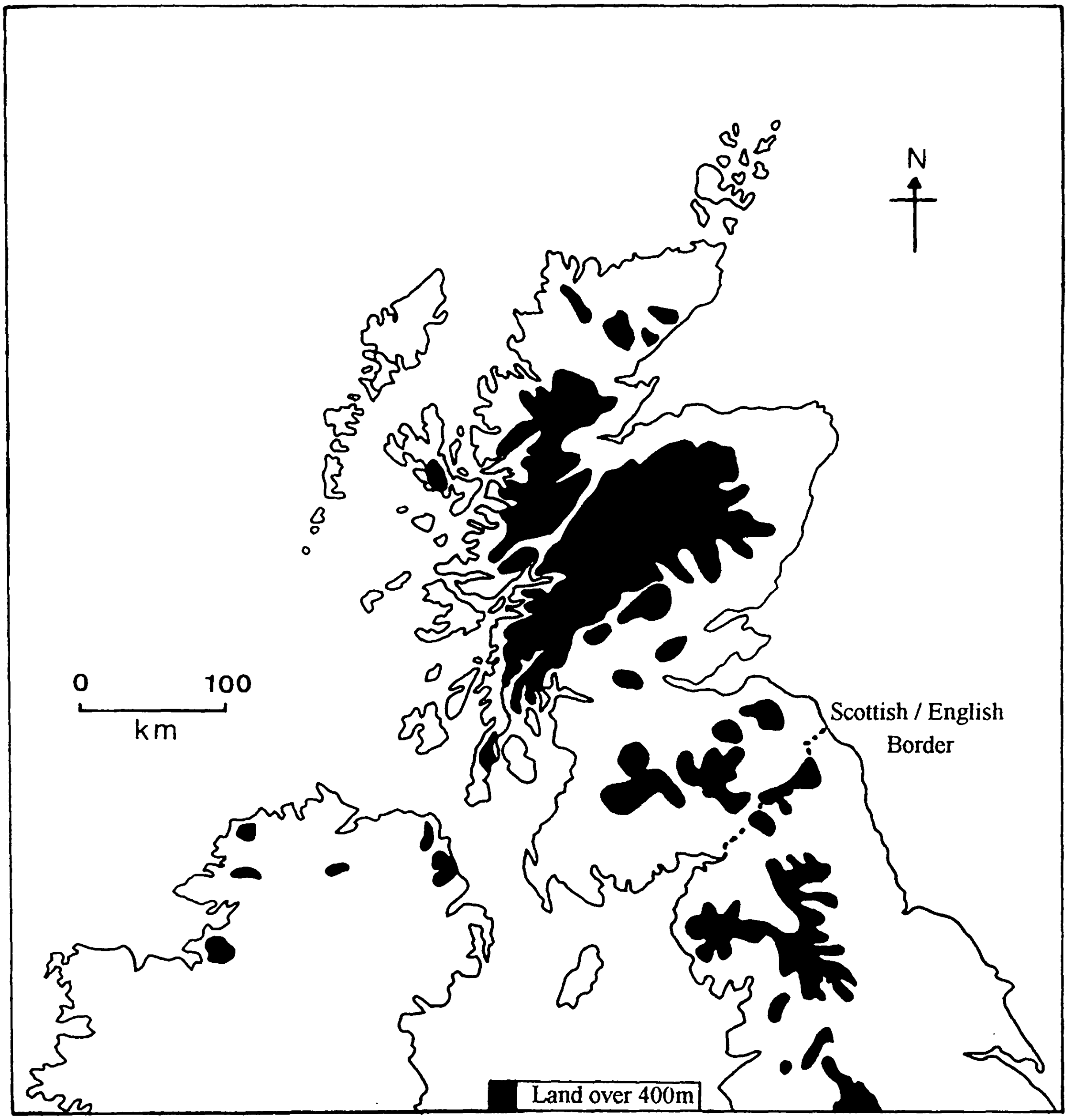
"open sections have the advantage that thin (1 to 2 mm) tephra layers, which can be discontinuous, can be discerned and followed in exposures; whereas a drill core from a spot chosen for coring may or may not show the very thin tephra layer."

It is suggested that the patchiness visible in Icelandic deposits might reflect the way in which tephra settles upon the ground surface and that interception of tephra by vegetation could result in patchy ground cover, as might variations in microtopography, with tephra deposited during rainfall being concentrated in low-lying areas due to localised transportation.

It is proposed that the discontinuous nature of visible tephra horizons might be mirrored by similar discontinuities in Scottish tephra deposits and that the absence of tephra in a single peat core does not preclude its presence on the site. However, the extent to which this difficulty may be overcome appears to be limited. Palaeoecological studies are often reliant on material from cores, and the microscopic nature of the Scottish tephra horizons prevents on-site assessment of cores for the presence of tephra. The possibility that tephra was present at the sites investigated but not present in the cores examined cannot be dismissed. However, it is considered unlikely that this factor accounts for the absence of five separate tephra horizons across three sites.

It is proposed that a key factor in the location of microscopic tephra deposits in peat cores lies in establishing the most likely location of the horizon and focusing attention upon this area. Work by Van den Bogaard *et al.* (1994) has demonstrated that it is possible to recover very small grained deposits (in this case Hekla 3) from single cores. This success was achieved through a very detailed study of sediments, accurately focused upon the basis of known sediment accumulation rates. However, it is suggested that if in order to locate a tephra one must first know the age of the sediments, the value of tephra as an independent dating tool is greatly reduced.

Figure 31 showing land over 400m in the north of Britain.



It is recognised that the presence of very small shards of tephra in the GISP records indicates that tephras may be ubiquitous. However, the current concentration techniques are unable to isolate these grains and will have to be further refined before the tephra records of lowland areas in the East of Scotland may be successfully tackled.

4:4 - Conclusions

The absence of tephra at the three sites investigated suggests that the frequency and intensity of ashfall from Icelandic eruptions may have been limited in extent in this area of lowland Scotland; although the presence of tephra at Black Loch (eruption and date as yet not geochemically determined) indicates that limited deposition of tephra has occurred across this area during the Holocene.

It is proposed that the majority of tephra fallout occurring over Scotland may have taken place in the areas of highest rainfall (in the west of Scotland) and in areas where rainfall is triggered by the presence of high ground (see figures 30 and 31). The position of the study area on low ground on the eastern coast of Scotland may therefore have significantly reduced the likelihood of tephra deposition, resulting in at best a patchy distribution.

It is concluded that the apparently patchy deposition of tephra across this area substantially reduces its value as a dating tool and effectively prevents the construction of tephra iscochrones and the establishment of a tephrochronological framework within this area.

An awareness of the above limiting factors during the selection of sites for investigation may substantially increase the likelihood of locating tephra and that sites chosen with reference to topography (favouring exposed or highland areas) and dominant wind patterns (favouring areas with an unimpeded position along likely fallout paths), are likely to yield a more comprehensive sequence of tephra deposits than sites in areas of low rainfall or on the leeward side of high ground. These proposals are based upon present prevailing wind directions and it is recognised that fluctuations are likely to have occurred during the Holocene. This hypothesis requires further research if it is to be validated or disproved.

Difficulties caused by the probable discontinuous nature of thin tephra horizons in Scotland are more difficult to resolve. Analysis of a number of cores for tephra at each site considered is advised. However, it is recognised that in practice time and resources often limit the researcher to a single core, and the investigation of multiple cores would not necessarily guarantee success, as tephra may be entirely absent from the site owing to other factors.

It is recognised that the present patterns of tephra distribution shown in figure 30, which appear to support the hypothesis stated above, with the majority of sites located in areas of high rainfall or exposed positions, may simply reflect the areas in which investigations have been undertaken. If an accurate picture of tephra deposition is to be established a network of sites spanning Scotland must be investigated for tephra, allowing the distribution and limits of different ashfalls to be located and mapped. Clearly if this approach is to prove successful researchers must state which sites failed to provide evidence of tephra, as these sites will prove critical in mapping the limits of the fallout zones of individual volcanic events.

Part Two: Results and preliminary discussion.

The results of this study are presented in a series of chapters. Chapter Five presents the results from Cruvie, Chapter Six the results from Pitbladdo and Chapter Seven the results from Methvern. Each chapter discusses the radiocarbon dates (5:1, 6:1, 7:1), sediment stratigraphy and sedimentary record (5:2, 6:2, 7:2); local pollen assemblage zones (5:3, 6:3, 7:3) and vegetation histories (5:4, 6:4, 7:4), synthesising the data from previous sections, of each site. These chapters form the core of the discussion in Chapter Eight.

At all sites local pollen assemblage zones (LPAZs) are primarily defined on the basis of changes in arboreal pollen, as pollen from arboreal taxa forms the dominant category for the majority of the Holocene at the sites under investigation. Exceptions to this rule occur in those parts of the diagram in which arboreal pollen falls to low levels, or where significant changes occur in the pollen curves of non-arboreal taxa. The interpretations provided highlight significant changes, upon which zonation has been based. The pollen diagrams to which these descriptions relate are located in the folder at the back of this volume.

Chapter Five - The palaeoenvironmental record at Cruvie.

5:1 - Introduction

The sediments examined from Cruvie cover the period from approximately 9800 to 3900 BP (Section 5:2) and provide a detailed palaeoenvironmental record for most of the Holocene. Sedimentary data are presented in figures 32 to 38 and tables 12 to 13. Pollen data are presented in figures 39 and 40. Summary diagrams referred to in the text are located at the end of section 5:5. The raw data used in the production of these figures and tables are presented in Volume Two, Appendix Two.

5:2 - Radiocarbon dates.

Five radiocarbon assays were obtained on material from Cruvie (table 12). These assays form the chronological framework for the site and are used in the calculation of the time-depth curve (figure 32) and pollen influx rates (figure 33). For details of these calculations refer to 2:3:1:5 and 2:3:1:5. Throughout the text all dates are expressed in uncalibrated years BP (before 1950 AD).

Table 12 details of the radiocarbon assays from Cruvie.

Laboratory number	Mean depth (cm)	Sediment thickness (cm)	Fraction	^{14}C age BP	1 σ	$\delta^{13}C$ ‰	Calibrated age range BC (1σ)
GU4038	186	184 - 188	Humin & Humic	6220	70	-31.2	5239-5076 BC
GU4039	312	310 - 314	Humin & Humic	7830	90	-31.1	6780-6503 BC
GU4040	362	360 - 364	Humin & Humic	8480	70	-30.6	Outwith range of calibration
GU4041	440	438 - 442	Humin & Humic	9250	80	-31.7	Outwith range of calibration
GU4042	487	485 - 490	Humin & Humic	9750	60	-34	Outwith range of calibration

5:2:1 - The reliability of the radiocarbon assays from Cruvie.

The presentation and preliminary discussion of results undertaken in this chapter and the later discussion undertaken in Chapters six to eight makes extensive use of the time-depth curve (figure 32), the accuracy of which depends on the validity of the radiocarbon dates upon which it was calculated.

During fieldwork a closed chambered corer was used to retrieve sediment cores, decreasing the possibility of contamination. In the laboratory, material was sampled from the same sediment core for both pollen analysis and radiocarbon dating, ensuring material dated was contemporaneous

Figure **32** Time-depth curve for sediments from Cruvie.

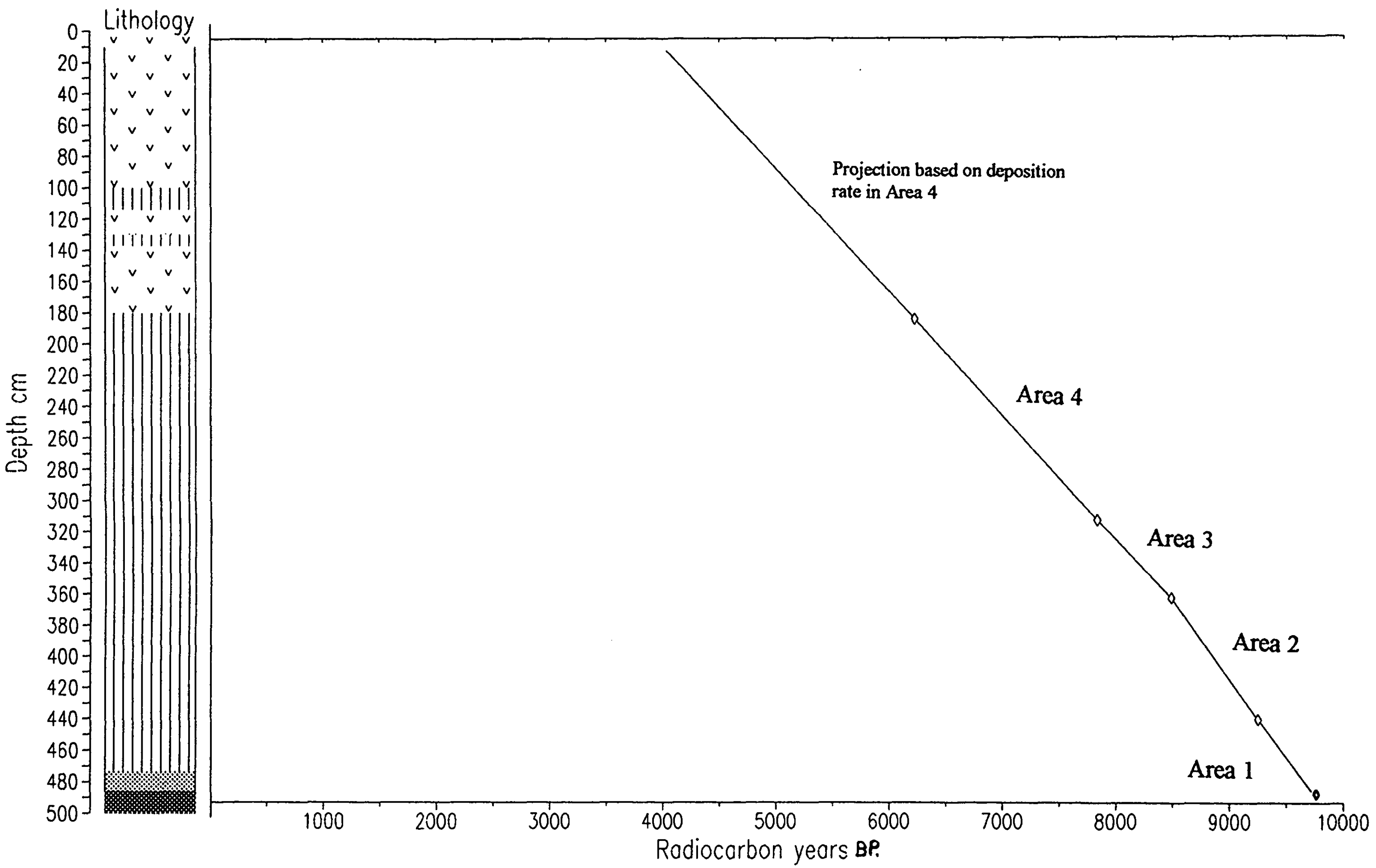


Figure 33 Concentration, grains cm $^{-3}$ wet sediment x 10^3 and Influx, grains/cm/year for Cruvie.

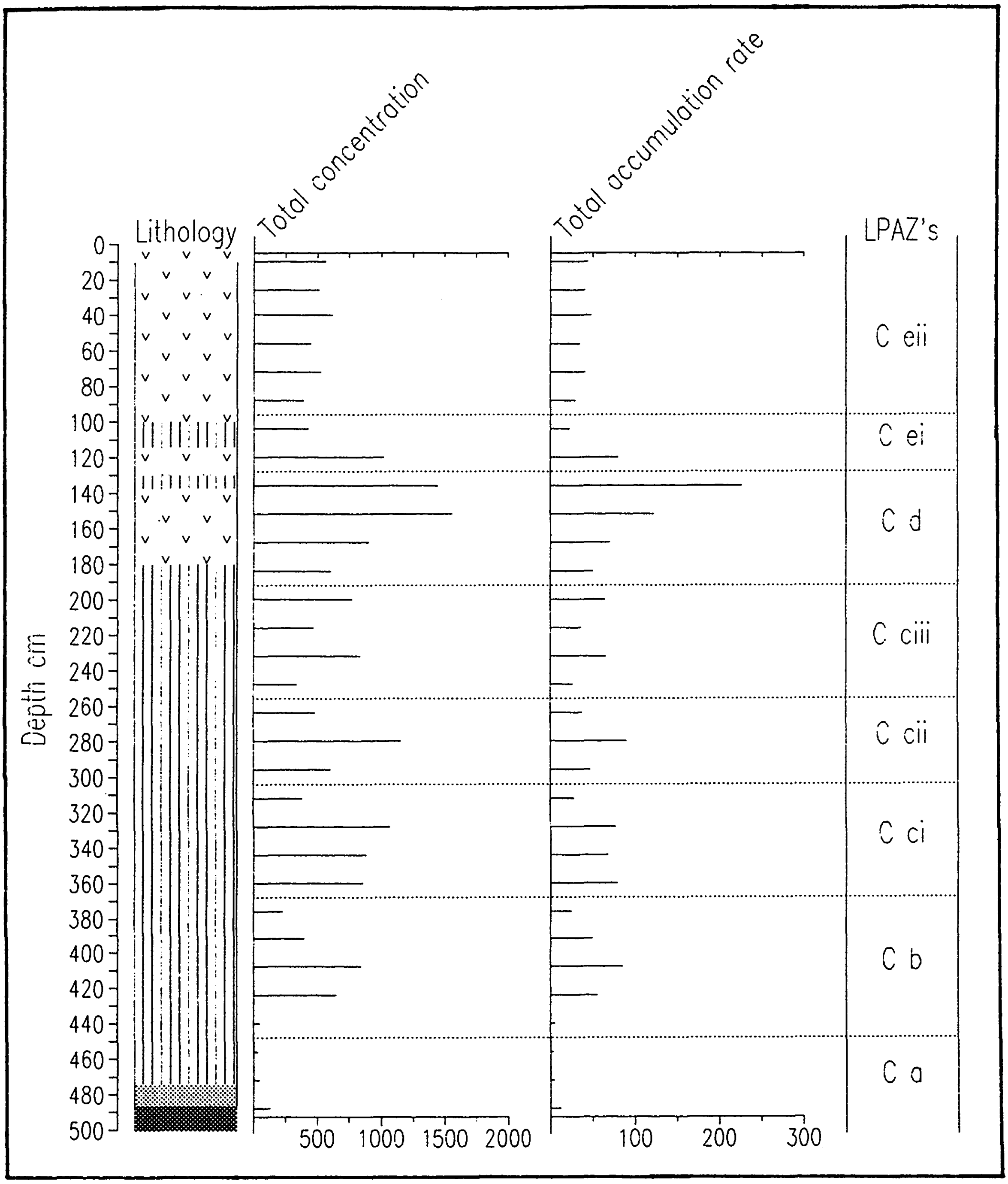
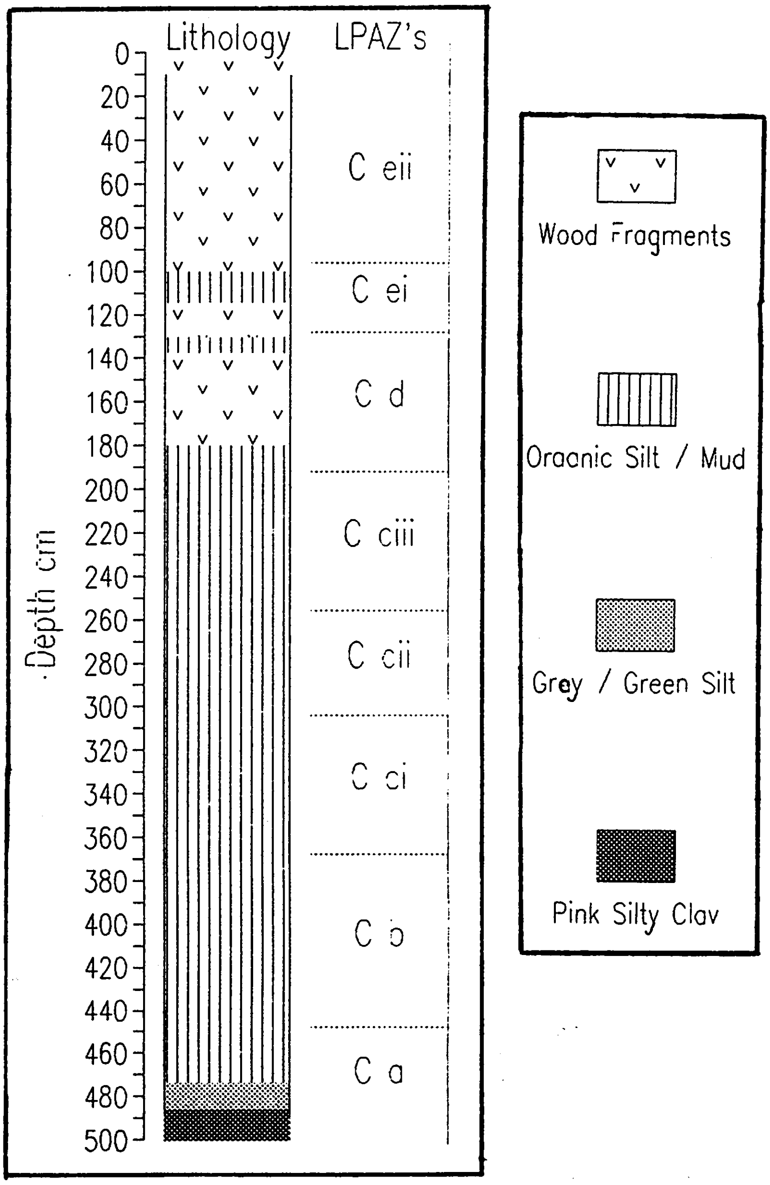


Figure **34** Lithology for Cruvie.

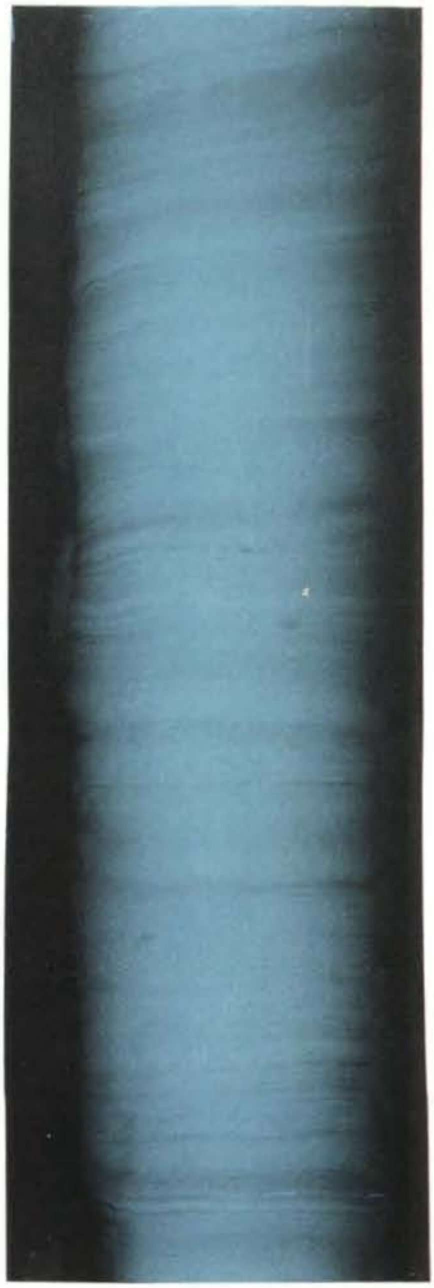


X - radiograph 1 - Wood fragments (light areas) in a peat core from Cruvie.

X - radiograph 2 - Laminations (light and dark bands) in late-glacial sediments from Cruvie.

1

2



with the pollen samples analysed. Before processing the outer layer of the sediment selected for dating was removed to prevent contamination by modern material. Any roots and macrofossils such as fragments of wood were removed from the sediment by handpicking to prevent contamination by younger material.

The pH values of the sediments dated indicated that they were acidic in nature, the sediments showed no reaction to HCl during processing and hard-water error is considered unlikely. The dates obtained from Cruvie are sequentially consistent suggesting that no large-scale reworking of sediments has occurred. A comparison of dates for similar events at Cruvie and other local sites is undertaken in Section 5:5 and suggests that the timing of events at Cruvie are distinct from those recorded elsewhere in the study area. However, on the basis of the available evidence it is suggested that there is little reason to consider that the dates obtained from Cruvie are incorrect, and that any differences between the dates recorded at Cruvie and dates obtained for similar events at other local sites are a reflection of local ecological conditions within the small pollen catchment at Cruvie.

5:3 - Sediment stratigraphy.

The sediment stratigraphy recorded at Cruvie is shown in table 13 and figure 34. A total of 716 cm of sediments was recovered from Cruvie. The basal 230 cm of sediment are comprised of inorganic bands of clay, silts and sand (X-radiograph 2). The radiocarbon date of 9750 +/- 60 years BP obtained from sediments between 485 to 490 cm suggests that these basal sediments relate to the Devensian Late-glacial, a period outwith the scope of this research and no further work was carried out on these sediments. These deposits are overlain by 12 cm of grey / green silts (474 to 486 cm). A sharp boundary between the grey / green silts and an amorphous organic silt / mud is recorded at 474 cm (ca. 9600 years BP). The upper 474 cm of the site comprises amorphous organic silt / mud, with three sub-units containing fragments of well preserved wood. X-radiograph 1 shows wood fragments present between 140 and 170 cm.

Table 13 details of the sediment stratigraphy recorded at Cruvie.

Depth in cm	Sediment type
0 - 100	Organic silt / mud containing wood fragments, gradual transition to
100 - 114	Amorphous organic silt / mud, gradual transition to
114 - 130	Organic silt / mud containing wood fragments, gradual transition to
130 - 137	Amorphous organic silt / mud, gradual transition to
137 - 180	Organic silt / mud containing wood fragments, gradual transition to
180 - 474	Amorphous organic silt / mud, sharp transition to
474 - 486	Grey / Green silt, sharp transition to
486 - 500	Pink silty clay.

5:4 - Sedimentary history.

This section outlines the main features of the sedimentary record at Cruvie. The sedimentary data comprises measurements of pH, loss on ignition, magnetic susceptibility, pollen preservation, concentration and sediment deposition rates and are summarised in Figures 33 to 38. The primary data used in the production of these figures are presented in Volume Two Appendix Two.

The pH of sediments may offer a guide to their chemical status. Although pollen is capable of surviving under a variety of conditions (see 1:6), it is generally best preserved in slightly acidic sediments that are subject to only limited microbial activity. The major changes in pH values recorded at Cruvie (figure 35) are closely linked to changes in sediment stratigraphy. The pH readings from the silty clay at the base of the core range between 7.2 and 7.5, indicating the presence of neutral conditions. However, readings from the grey / green silt overlying the silty clay and the organic silt / muds, which form the dominant sediment type at this site, fluctuate between 4.7 and 5.4, indicating the presence of acidic conditions suited to the preservation of pollen.

Loss-on-ignition readings from Cruvie (figure 36) show that the basal clays, dating from ca. 9750 BP contain only a limited amount of organic material (5 % to 6 %), indicating that developing soils at the start of the Holocene were highly unstable and supported little vegetation. The organic content of the silt band overlying the clays is slightly higher at 12 %, suggesting a limited increase in vegetation cover. The change to silt / mud deposits marks the start of a gradual increase in organic matter from 17 % at 472 cm to 51 % at 452 cm, and is considered to reflect a substantial decrease in sediment mobility and the establishment of extensive vegetation cover between ca. 9580 and ca. 9410 BP. Levels of organic material remain at around 50 % between 452 cm and 440 cm, before a further sharp increase to 83 % at 436 cm. It is suggested that this increase in organic content reflects the final stabilisation of the area adjacent to the site at ca. 9250 BP.

The remaining deposits were generally highly organic in nature, with values fluctuating between 80 % and 90 % organic matter for the majority of the core. However, increases in mineral content are recorded at several depths, including an increase to 33 % at 240 cm (ca. 6910 BP), 17 % at 96 cm (ca. 5020 BP) and 16 % to 19 % between 60 and 64 cm (ca. 4640 to 4690 BP). Increases in mineral content appear as troughs in figure 36.

Magnetic susceptibility readings from Cruvie (figure 37) are of interest primarily due to the almost total absence of magnetic minerals from the record during the Holocene period. Although it is recognised that organic deposits are generally low in magnetic mineral content (Oldfield *et al.* 1978), it was hoped that the increases in mineral matter recorded by LOI, might also be detected using magnetic susceptibility. The small peak in susceptibility (0.1) registered between 150 to 152 cm (ca. 5810 BP), does overlap with an episode of increased mineral input (figure 36); however, this single minor correlation is considered to be of only limited interpretational value.

Figure 35 pH diagram for Cruvie.

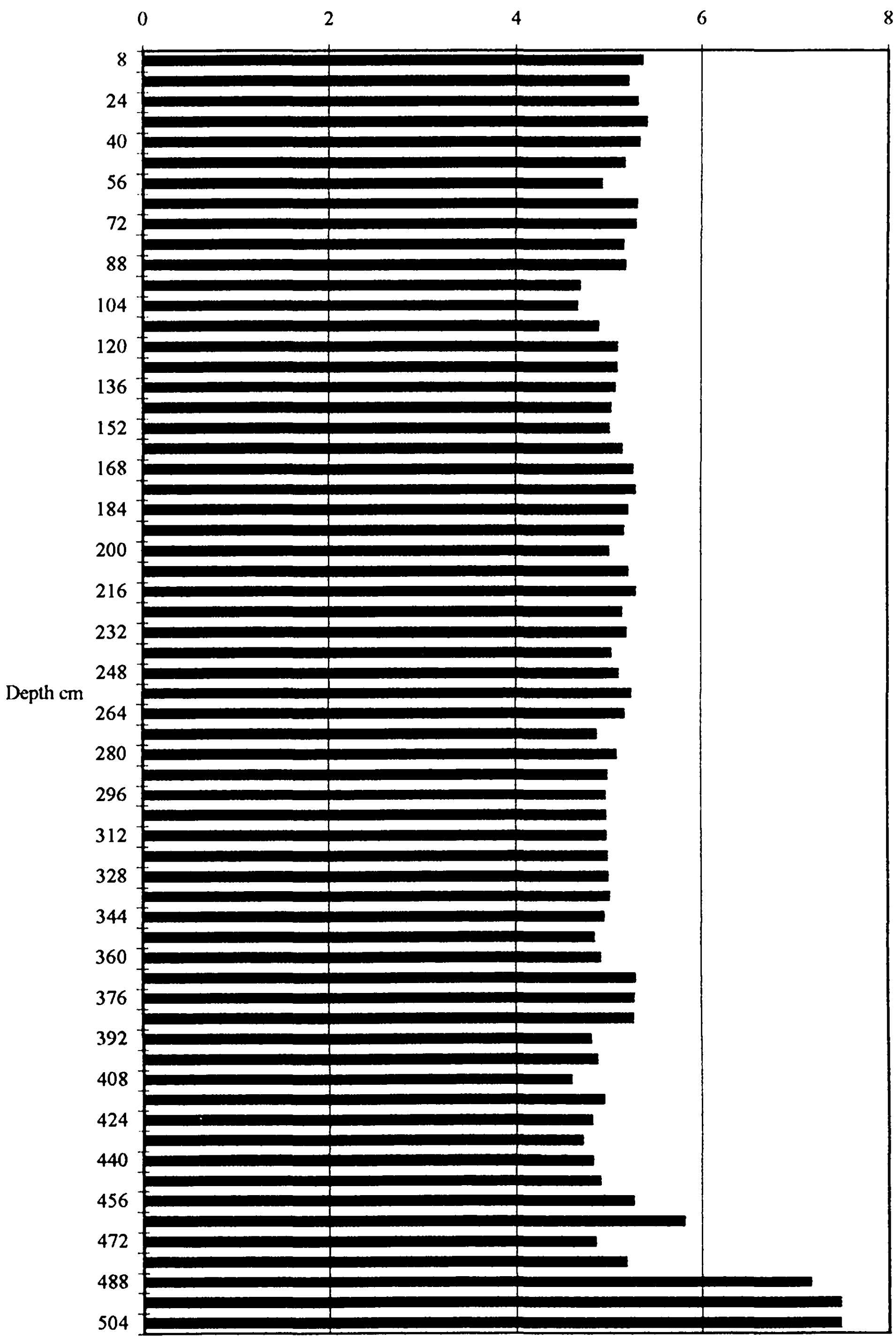
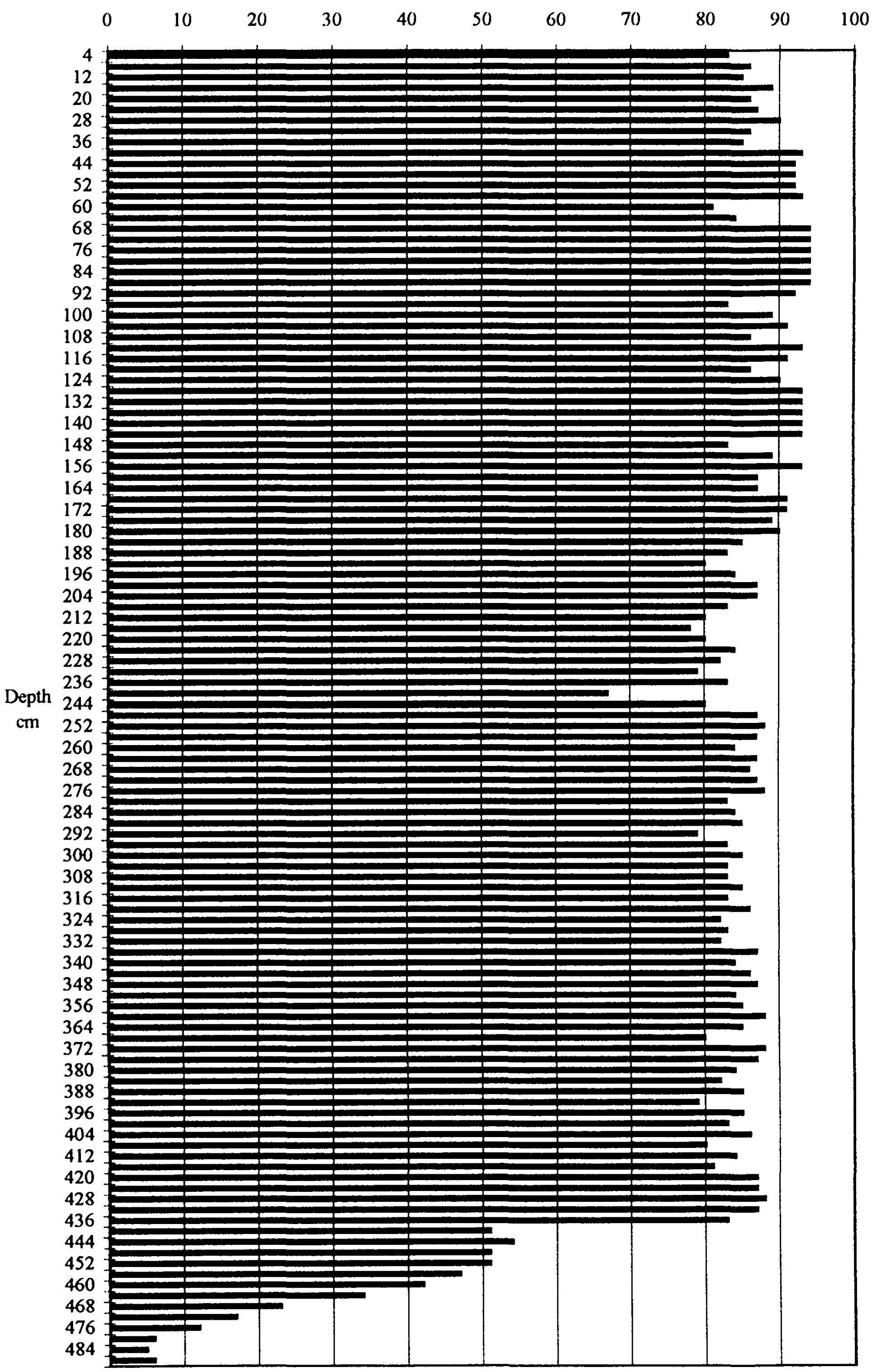


Figure 36 Loss on ignition for Cruvie



An increase in susceptibility readings was recorded in the silts and clays at the base of the core, a change that corresponds to the high levels of mineral matter recorded by LOI within these early Holocene sediments. The 2.30 m of sediments relating to the Devensian (figure 37) have a strong magnetic susceptibility signature. It is suggested that detailed analysis of these sediments on a finer scale than that undertaken during this study, might reveal a strong link between variations in magnetic susceptibility and the pattern of laminations revealed by X-radiography (X-radiograph 2).

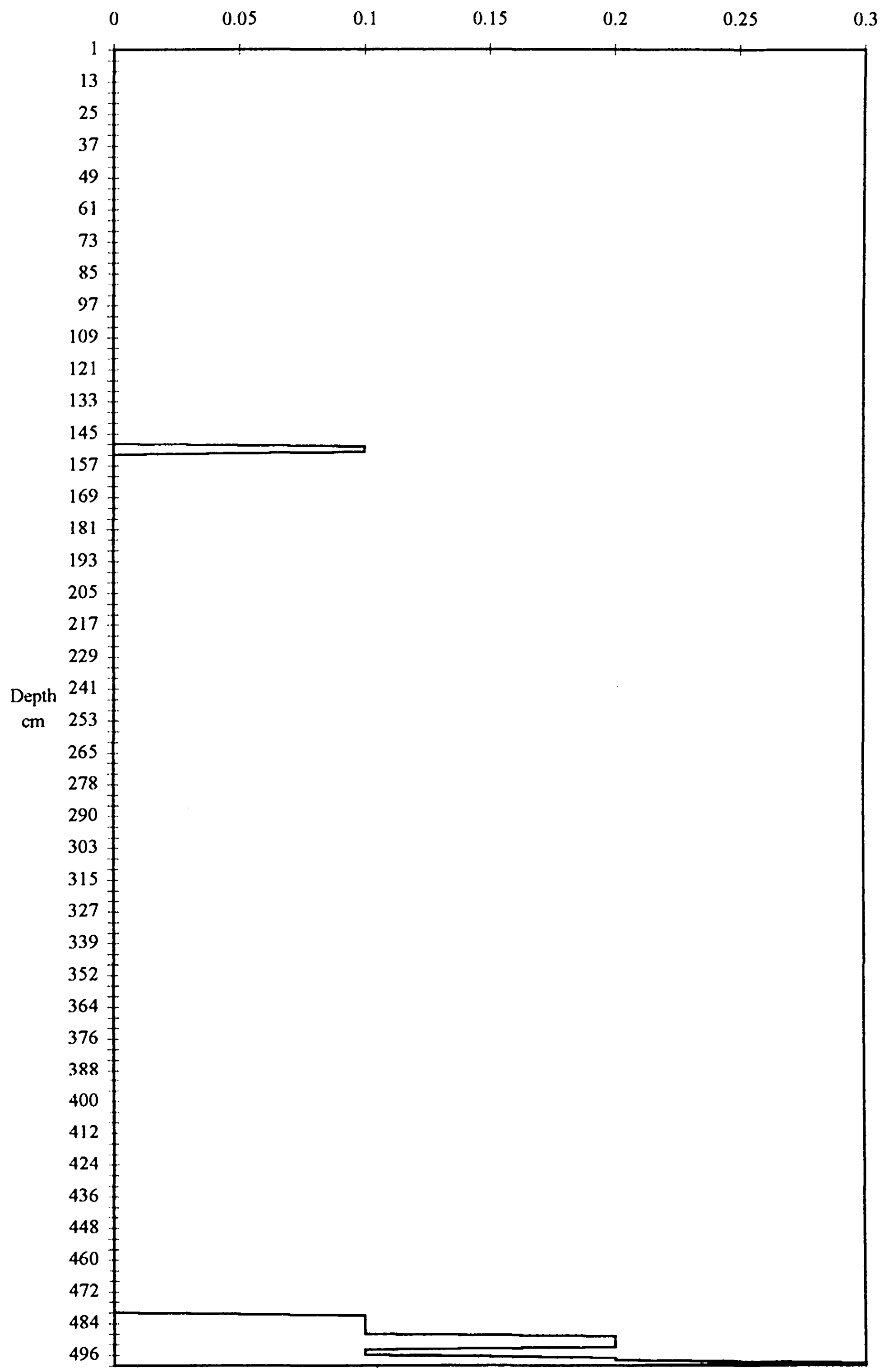
Pollen preservation can be strongly influenced by the depositional environment (Lowe 1982) and changes in pollen preservation may provide a guide to changes occurring in this environment. Pollen recovered from the basal sediments at Cruvie (figure 38) shows a high percentage (up to 81 %) of mechanically damaged (crumpled and split) grains, with a smaller percentage (up to 7 %) of biologically or chemically damaged (corroded and degraded) grains. Pollen deposited in these sediments may have been inwashed from the surrounding area and the damage recorded predominantly caused by transportation and exposure to oxidising conditions before deposition.

Pollen preservation throughout the rest of the core is generally good with well preserved pollen accounting for between 80 % and 90 % of the pollen sum. The predominance of well preserved pollen reflects the highly organic, acidic and stable nature of the sedimentary environment into which it was incorporated. However, figure 38 clearly shows that episodes of increased pollen damage occurred throughout the core. For example between 392 cm and 424 cm (ca. 8780 to 9090 BP) levels of mechanically damaged pollen accounted for up to 42% of the pollen sum, and similar changes occurred at 264 cm to 296 cm (ca. 7220 to 7630 BP) and 152 cm to 168 cm (ca. 5810 to 6020 BP). An examination of the LOI record and pH records gives no clear indication of changes that might have resulted in a deterioration in pollen preservation. An increase in mineral content might have suggested the introduction of damaged pollen from a secondary source, whilst a decrease in sediment acidity may have suggested a possible increase in microbial activity and a consequent increase in the representation of corroded pollen grains. The changes in pollen preservation recorded indicate that variations in depositional conditions occurred, but the available sedimentary data do not permit the recognition of causal factors.

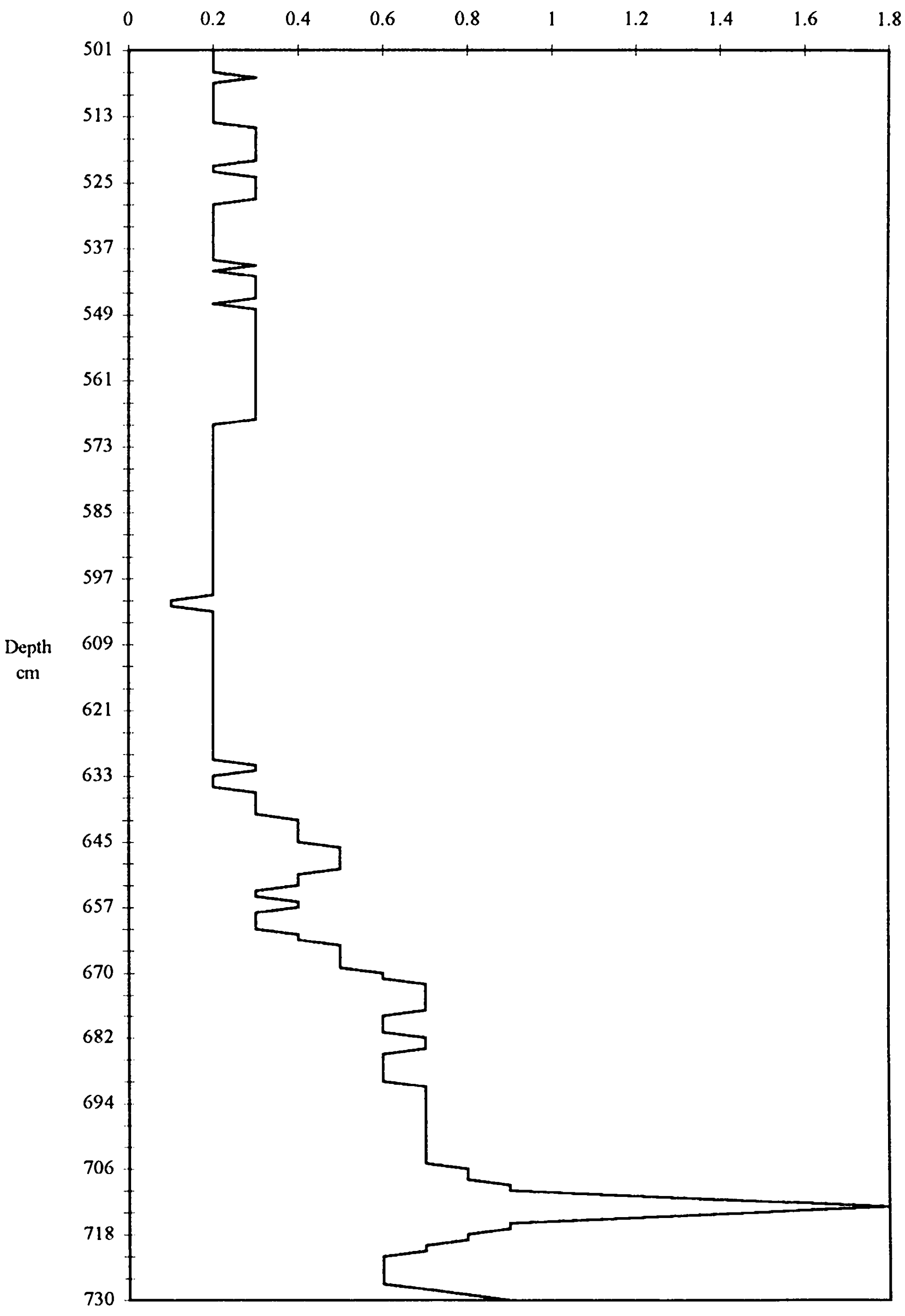
Sediment deposition rates at Cruvie show little apparent variation (figure 32). A deposition rate of 0.09 cm yr^{-1}, 11 yr cm^{-1} is recorded at the base of the core (area 1), increasing slightly to 0.10 cm yr^{-1}, 10 yr cm^{-1} (area 2) before falling to 0.08 cm yr^{-1}, 13 yr cm^{-1} for the remainder of the core (areas 3 and 4). Although sedimentation rates at this site appear to be almost constant it is considered likely that sedimentation rates would have fluctuated in response to changes in sedimentary conditions and that the form of the time-depth curve (figure 32) is a reflection of the limited number of radiocarbon dates available at this site.

Pollen concentrations and influx rates (figure 33) calculated on the basis of sediment deposition rates show considerable fluctuations but mirror each other throughout the core. The

Figure 37 Magnetic susceptibility for Cruvie.



Continuation of Figure 37 Magnetic susceptibility for Cruvie.



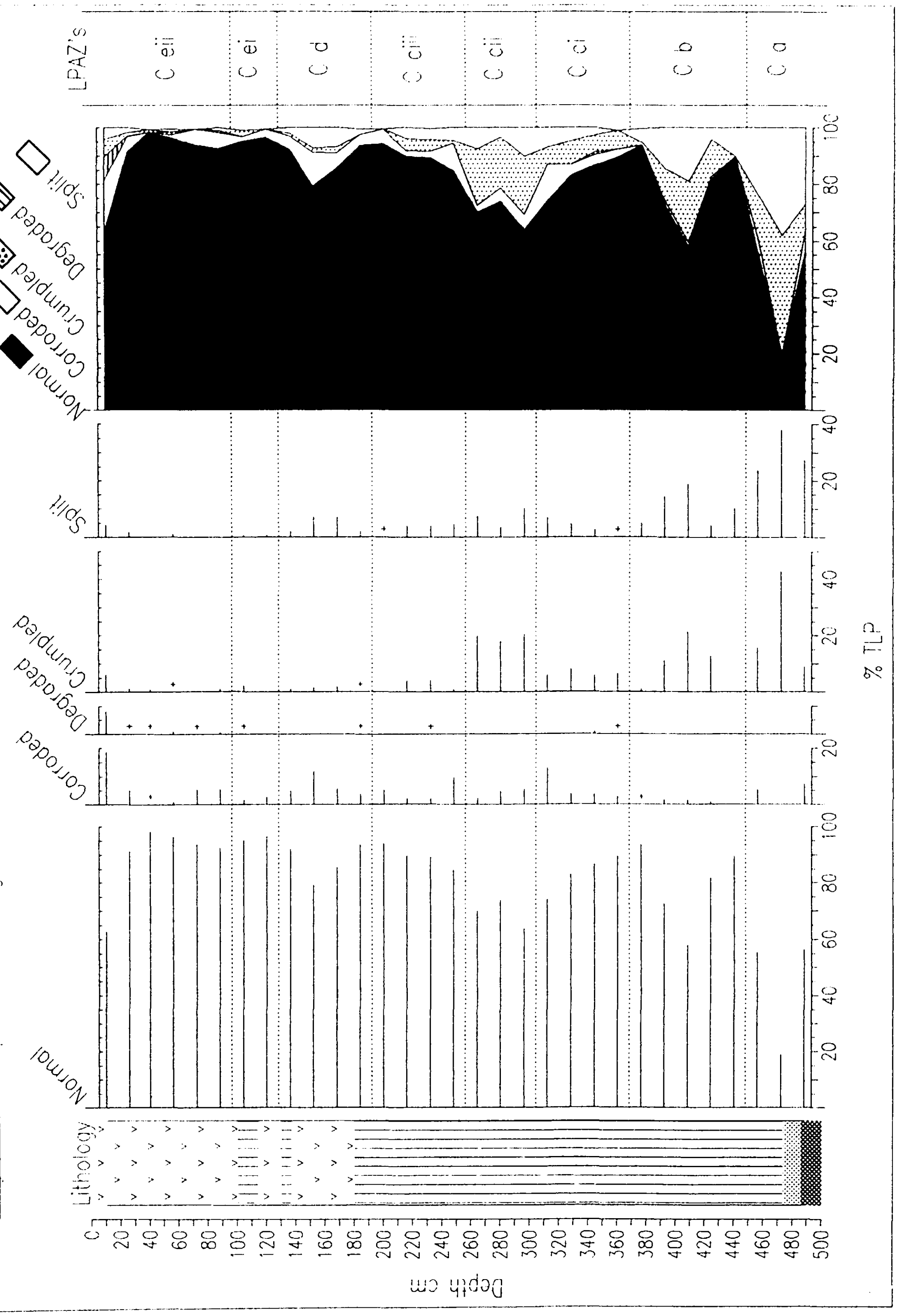


Figure 38 Pollen preservation diagram for Cruvie.

extremely low concentrations recorded between 440 cm (ca. 9250 BP) and 488 cm (ca. 9750 BP) are considered to reflect the presence of a small number of plant species producing only a limited amount of pollen in the period immediately following deglaciation. The fluctuations in pollen concentrations recorded throughout the rest of the core (from a low of 34 x 10^3 grains cm^{-3} at 248 cm to 15 x 10^4 grains cm^{-3} at 152 cm) are considered to reflect changes in the composition of the surrounding vegetation, with higher values occurring in those periods when high pollen producers, for example arboreal taxa such as *Alnus*, are dominant in the area surrounding the site. See section 5:5.

5:5 - Local Pollen Assemblage Zones (LPAZs).

The pollen diagrams from Cruvie (figures 39 and 40) are divided into eight LPAZs based on changes in the major taxa in the percentage pollen diagram. The diagrams span the period from ca. 9750 to 3870 years BP. The dates referred to in the text are extrapolations based upon the time-depth curve (figure 32).

LPAZ	Depth range (cm)	Age range (uncalibrated years BP)
C cii	89 - 0	4990 - 3870
C ei	121 - 89	5610 - 4990
C d	185 - 121	6220 - 5610
C ciii	249 - 185	7010 - 6220
C cii	297 - 249	7630 - 7010
C ci	361 - 297	8480 - 7630
C b	441 - 361	9250 - 8480
C a	488 - 441	9750 - 9250

<u>LPAZ C a</u> : 488 to 441 cm - ca. 9750 to 9250 years BP.

The basal sediments at Cruvie contain only a limited number of taxa (figure 39) and pollen concentrations are very low (figure 40). This zone is dominated by *Pinus* pollen, which represents between 80 % to 90 % Total Land Pollen (TLP) and high levels of microscopic charcoal. The end of the zone is marked by a sharp fall in *Pinus* values to 20 % TLP, the occurrence of a high level of Filicales pollen (70 % TLP), the first occurrence of *Sphagnum* spores and the disappearance of *Juniperus* from the pollen record.

<u>LPAZ C b</u> : 441 to 361 cm - ca. 9250 to 9250 BP.

This zone is characterised by a large increase in the number of herbaceous taxa present at low (1 % or less) levels. During this period *Betula* pollen is recorded for the first time at 424 cm

(12 % TLP) and its levels increase rapidly to reach a maximum of 50 % TLP at 392 cm, before falling to 7 % TLP at the end of the zone. Levels of *Pinus* pollen remain low but stable (5 % to 8 % TLP) throughout this zone. The *Corylus* expansion and maximum is also recorded in this zone, with pollen levels rising from 5 % at 404 cm to 75 % TLP at 360 cm. Gramineae pollen percentage values fluctuate considerably, ranging from 2 % to 45 % TLP. Other features of this zone include a decline in Filicales spores throughout this zone (70 % to 1 % TLP), and the high values of both Ericaceae (14 % TLP) and *Typha* (20 % TLP) pollen recorded at 424 cm.

<u>LPAZ C ci</u> : 361 to 297 cm - ca. 8480 to 7630 BP.

Arboreal pollen levels fluctuate between 10 and 18 % in response to small changes in individual taxa, particularly *Betula*. A steady fall is recorded in *Corylus* pollen values throughout this period from 75 % to 55 % TLP. *Quercus* pollen is noted sporadically at less than 1 % TLP during this zone. The values of Gramineae pollen and Filicales spores remain consistently low, although Gramineae levels do increase slightly towards the end of the zone.

<u>LPAZ C cii</u> : 297 to 361 cm - ca. 7630 to 7010 BP.

This zone is characterised by a steady increase in arboreal pollen from 20 % to 40 % TLP, a trend that reflects the slight but steady rise in *Betula* and *Ulmus* pollen percentages. The representation of *Corylus* pollen declines gradually for most of the zone before stabilising at 25 % TLP. Overall, Gramineae pollen values are considerably higher than those recorded in LPAZ Cci reaching a peak of 20 % TLP.

<u>LPAZ C ciii</u> : 249 to 185 cm - ca. 7010 to 6220 BP.

The start of this zone is marked by a drop in Gramineae pollen levels to only 8 % TLP at 248 cm. This level also marks the beginning of the continuous presence of *Quercus* pollen, the first occurrence of *Alnus* pollen (< 1 % TLP) at this site and an increase in *Pinus* pollen to 8 % TLP. The first *Ulmus* decline at this site is recorded in Cciii, with values falling from 12 % TLP at 216 cm to 3 % TLP at 200 cm and remaining low for the rest of the zone. Levels of *Betula*, *Quercus* and Gramineae pollen all remain stable throughout this zone. Other features include the presence of Cyperaceae pollen at levels consistently greater than 6 % TLP and the continuous presence of *Rumex* pollen at values greater than 1 % TLP, with a peak of 12 % TLP being recorded at 216 cm. *Nymphaea* pollen is recorded during the second half of this zone; its arrival at 216 cm (17 % TLP plus aquatics) corresponds to a sharp drop (10 % to 2 %) in Filicales spores. The end of the zone marks the first occurrence of *Alnus* pollen at values greater than 1 % TLP.

<u>LPAZ C d</u> : 185 to 121 cm - ca. 6220 to 5610 BP.

Overall there is an increase in arboreal pollen during this period, rising from 35 % to 59 % TLP (figure 42) by the end of the zone. However, at 152 cm there is a sharp drop in *Betula* pollen and slight increases in *Quercus*, *Ulmus* and *Corylus* pollen. Levels of herbaceous pollen remain stable throughout this zone. *Nymphaea* pollen is continuously present but its representation fell steadily from 8 % TLP at 184 cm to 1 % TLP plus aquatics at 120 cm. *Alnus* pollen is present throughout at low levels (< 5 % TLP), the end of the zone marking the start of its rapid expansion.

<u>LPAZ C ei</u> : 121 to 89 cm - ca. 5610 to 4990 BP.

This zone is characterised by fluctuations in individual arboreal pollen taxa. The zone covers the expansion in *Alnus* pollen from 10 % TLP to its maximum of 47 % TLP. *Ulmus* pollen percentages remain low except at 104 cm where it accounts for 15 % of TLP. This horizon also corresponds to a drop in *Alnus* pollen percentages (by 15 %), an increase in Gramineae pollen levels (from 5 % to 15 % TLP), the disappearance of *Quercus* from the record and the first occurrence of Ericaceae pollen at levels greater than 1 % since LPAZ Cb. A rapid decline in the representation of *Betula* pollen and an increase in the number of aquatic pollen taxa also occurs.

<u>LPAZ C eii</u> ; 89 to 0 cm - ca. 4990 to 3870 BP.

Arboreal pollen percentages remain generally stable, fluctuating between 54 % and 63 % TLP (figure 42). *Alnus* remains the dominant arboreal pollen taxa forming approximately 85 % of the arboreal pollen recorded. Gramineae pollen values fluctuate only slightly during the majority of this zone, at < 1 % to 5 % TLP, but increase at the end to 15 % TLP. During this zone there is an increase in the number of herbaceous pollen taxa recorded and *Plantago lanceolata* pollen occurs (< 1 % TLP) for the first time at 40 cm. Levels of *Corylus* pollen fluctuate slightly between 13 % and 25 % TLP.

5:6 - Vegetation History.

Throughout the following discussion a number of terms (after Bennett 1986a) are used to describe patterns of vegetation development as inferred from the pollen diagrams. 'Appearance' is defined as the intermittent occurrence of pollen grains of a particular taxon in the pollen record, but is not considered to indicate the presence of a local population of the taxon. 'Arrival' is defined as the first local presence of a taxon, and is recognised by the continuous presence, at low percentage values, of the pollen morphotype in the pollen record. 'Rise/expansion' is defined as an increase in the local population of a taxon, and is recognised by consecutive percentage increases in the representation of the taxon in the pollen record. 'Spread/range expansion' is defined as the movement of a taxon into and/or within a geographical area, and is recognised by variations in the timing of the arrival and expansion of a given taxon in the pollen records from the different locations within the study area.

5:6:1 - The early Holocene (ca. 9750 to 8480 BP).

Local pollen assemblage zone Ca covers a period of considerable change. Walker and Lowe (1982) argued that the formation of stable ground surfaces and the start of organic sedimentation within basins may have occurred from ca. 10 200 BP following the end of the Loch Lomond Stadial. At Cruvie the start of the pollen record is marked by the change from a non-polleniferous, pink silty clay to a polleniferous organic grey/green silt at 486 cm. The basal sediments of LPAZ Ca were dated to 9750 +/- 60 BP.

The sediments at the base of LPAZ Ca are predominantly inorganic (see 5:4) and probably reflect soil instability around the lake resulting in the inwashing of minerogenic material. As soil stability increased, magnetic susceptibility readings fell and there was a steady increase in the levels of organic matter, suggesting a decrease in the amount of inwashed mineral matter (see 5:4).

Pollen preservation is very poor in the basal horizons (see 5:4) and the presence of a high percentage of damaged pollen grains, in particular classes reflecting mechanical damage (crumpling and splitting), is considered to be consistent with physically unstable conditions. Preservation levels improve during LPAZ Ca, reflecting a reduction in mechanical damage as sediment movement declined in an increasingly stable environment.

Pollen concentrations and floristic diversity are both extremely low (figures 39 and 40), with only four taxa recorded during this initial stage (*Pinus, Juniperus*, Gramineae and Filicales). The pollen spectra recorded in LPAZ Ca are interpreted as reflecting an open landscape with little established soil cover. It is considered that Gramineae formed the dominant local vegetation with a small number of *Juniperus* and ferns also present. The susceptibility of *Juniperus* pollen to physical damage (Havinga 1984) may have led to the preferential loss of *Juniperus* pollen, and it is suggested that juniper may have been more strongly represented in the landscape than the pollen

Figure **41** Tree pollen percentage diagram for Cruvie.

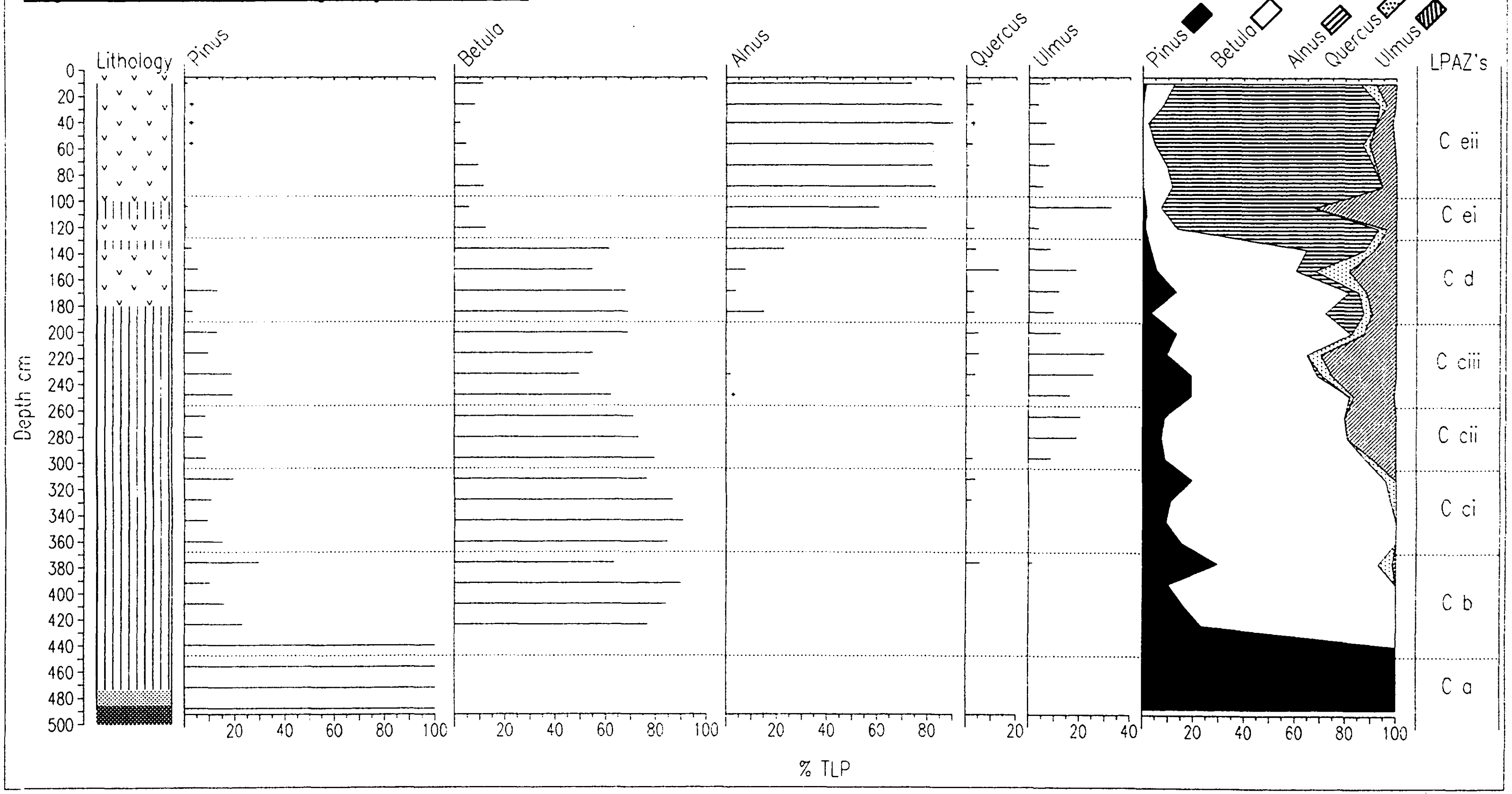
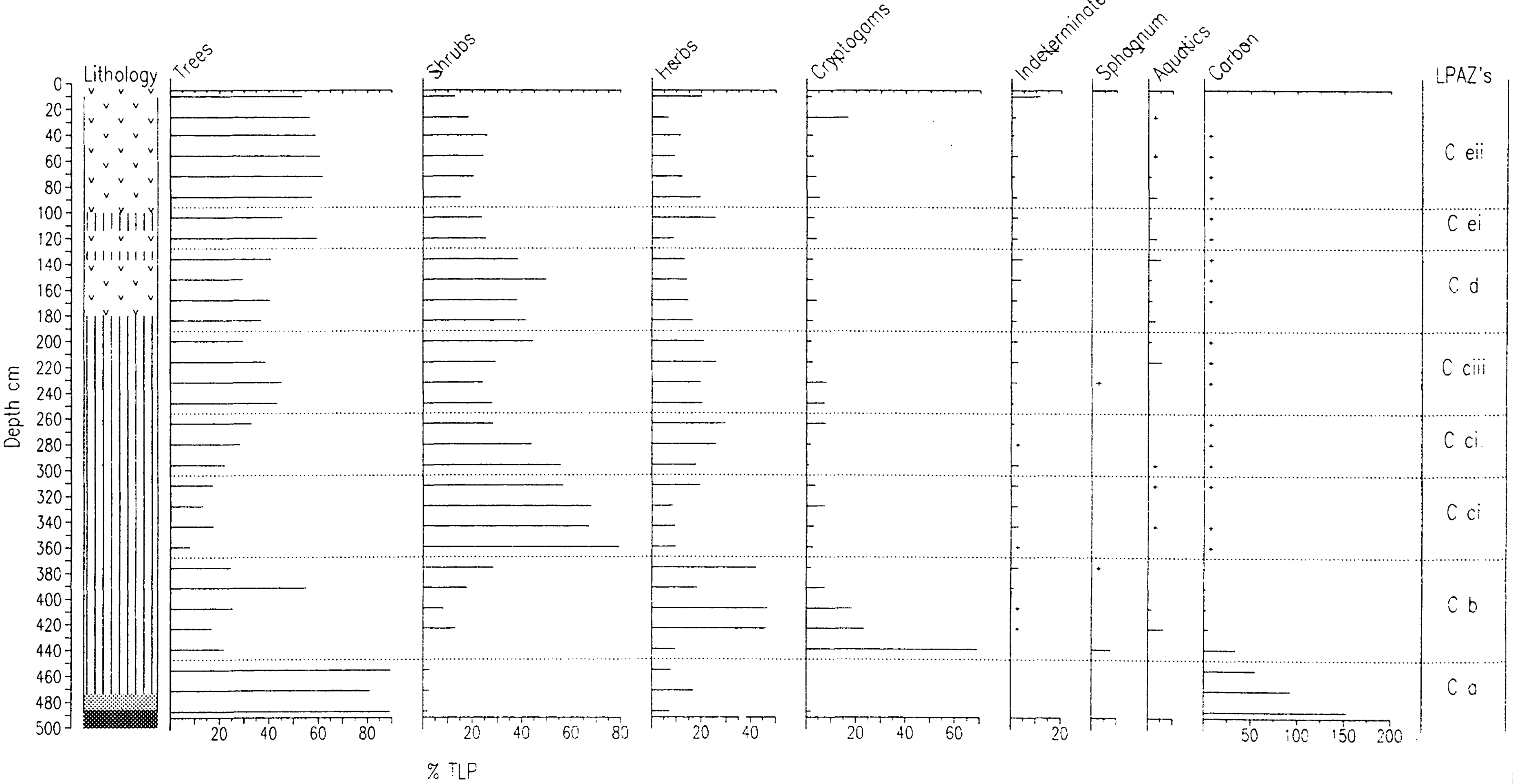


Figure 42 Selected pollen percentage diagram for Cruvie.



record indicates. It is also considered likely that other pollen taxa may have been lost from the palaeoecological record owing to the poor preservation conditions experienced.

Pinus pollen dominates this LPAZ with values of greater than 80% TLP (figure 39), although the low pollen concentrations meant that the actual number of grains recorded was not high. Despite these low concentrations a recognisable peak is recorded within LPAZ Ca. The presence of *Pinus* pollen in deposits of this age is problematic, as pine is not generally considered to have expanded into Scotland until ca. 8000 to 7500 BP, and did not reach its eastern margins, closest to this site, until ca. 6000 BP (Birks 1989). There are two likely sources for the *Pinus* pollen recorded during this part of the Holocene at Cruvie. These are:

1) Reworked pollen from older sediments - Several workers (Oldfield 1960, Birks 1973, Cundill and Whittington 1983) have suggested reworking as a possible origin for anomalous pollen taxa within cores. They hypothesise that pollen deposited in earlier interstadial periods was subject to transportation and re-deposition as the earlier sediments underwent degradation and erosion during the late-Devensian and early Holocene.

One local site that had unusual pollen spectra was Creich Castle in Fife (Cundill and Whittington 1983). This Late Devensian and early Holocene site contained a sequence of minerogenic sediments incorporating a range of thermophilous arboreal taxa, spanning the first 1500 years of the Holocene. This leads to the suggestion that:

"such a pollen spectrum would seem to favour reworking of earlier sediments, rather than long-distance wind transport" (Cundill and Whittington 1983, p.309).

However, a number of differences exist between the pollen record at Creich Castle and Cruvie. The *Pinus* pollen peak at Cruvie is not restricted to the minerogenic sediments, where the highest levels of reworking would be expected, but extended into the organic sediments. In addition, the sediments recovered at Cruvie had been deposited in a Late Devensian kettle-hole within an area of fluvioglacial sediments; therefore there is no discernible source of reworked sediment.

2) Long-distance wind transport - A second possible source of *Pinus* pollen is the long-distance wind-blown transportation of pollen from established areas. The *Pinus* isochrone map produced by Birks (1989) indicates that pine was established in southern England by approximately 9000 BP, at which time it was widely distributed but present in small numbers in any one location (Bennett 1984). The high levels of *Pinus* pollen occurred at Cruvie between 9750 +/- 60 to 9250 +/- 80 BP, at which time the closest source area seems to have been northern France (Huntley and Birks 1983).

Tipping (1989) suggested that peaks in *Pinus* pollen during the early post-glacial at sites in Western Scotland may be attributed to the long-distance transportation of *Pinus* pollen. Tipping (1989 p. 340) also suggested that the lack of a gradual increase in *Pinus* values might be linked to "lessening intensities in the general circulation system prevailing in the north Atlantic during the climatic amelioration" allowing an abrupt increase in the levels of pollen transported from more southerly regions during the early part of the Holocene. It is possible that the peak in *Pinus* pollen at

Cruvie may be attributable to the same shift in general air circulation that influenced the Western sites investigated by Tipping (1989).

On the basis of the available evidence the earliest part of the Holocene at Cruvie is considered to reflect a period of instability with a sparse local vegetation community producing low levels of pollen. The source of the *Pinus* pollen is most probably attributable to long-distance wind transportation, though the possibility of sediment reworking cannot be entirely ruled out. It is recognised that the poor preservation of pollen during this period means that the record may be heavily biased in favour of the more robust pollen taxa, of which *Pinus* is one (Havinga 1984). However, the presence of small quantities of *Juniperus* pollen (which is easily damaged: Havinga 1984) suggests that the pollen record is at least partly representative of the vegetation at this time. The low pollen concentrations during this initial zone (figure 40) are considered to reflect low local pollen productivity, permitting long-distance wind transported pollen to dominate the pollen assemblage.

The start of the next phase of vegetation development at Cruvie (LPAZ b) is marked by the arrival of *Betula* pollen at 9250 +/- 80 BP (440 cm). *Betula* pollen values increase rapidly reaching a maximum of 50% TLP for a single level at ca. 8760 BP (see figure 39). According to Birks (1973), values of 10 % TLP are indicative of an open birch woodland, and it is suggested that an extensive birch woodland was developing at Cruvie during this period.

The *Betula* pollen rise at Cruvie is considerably later than might be expected for this part of Scotland. Other dated sites in Fife at Creich Castle (Cundill and Whittington 1983), Black Loch (Whittington *et al.* 1990) and Pickletillem (Whittington *et al.* 1991) all placed the *Betula* rise within the limit of the 10 000 BP isochrone defined by Birks (1989).

The late arrival of *Betula* at Cruvie is considered to reflect the relatively late date at which surface stability was reached at this site. Differences between this site and other local sites are discussed in Chapter Eight. The apparently abrupt arrival of *Betula* pollen in the record (0 to 14 % TLP) may reflect its role as a pioneer coloniser of immature soils and the presence of established populations within Fife, which provided a ready source to colonise the local catchment area as soon as conditions stabilised and produced a rapid improvement in soil conditions. Alternatively, this pattern may be a reflection of the sampling interval at this site; the two levels are separated by approximately 200 years and *Betula* may have been steadily increasing in numbers throughout this period.

The improving edaphic conditions were reflected by the increase in palynological diversity, from an average of four taxa in LPAZ Ca to 14 in LPAZ Cb. Pollen concentrations also increased substantially in this zone indicating increased pollen productivity by a greater range of plant species.

Although birch woodland appears to have been extensive during this period (9250 +/- 80 to 8480 +/- 70 BP), the canopy was not closed. The range of herbaceous taxa and the high levels of Gramineae pollen indicate a fairly open canopy, whilst the presence of significant amounts of

Ericaceae and Filicales, during the first half of the LPAZ, suggests that before the *Betula* maximum there may have been areas of open heath land in the vicinity of the site.

The presence of aquatic taxa in the sediments indicates that the coring area was located in an area of open water. The presence of *Sphagnum* spores and *Salix* pollen is considered to reflect an area of wetland surrounding the open water. A brief phase of increased water depth may have occurred between 9250 +/- 80 and ca. 8600 BP, as during this period *Sphagnum* is briefly replaced by *Typha*, which is currently found most frequently in water depths of between 0.2 m and 2.0 m (Rieley and Page 1990). However, as this interpretation is based upon a change in a single taxon, its significance remains unclear.

During LPAZ Cb *Corylus* became a significant contributor to the pollen record. Throughout this study it is assumed that Coryloid pollen predominantly represents *Corylus avellana* rather than *Myrica gale*, although it is recognised that this assumption may not be entirely accurate. The arrival of *Corylus* was dated to ca. 8910 BP, approximately 330 years after *Betula*. Following arrival, pollen frequencies of *Corylus* expanded quickly reaching a maximum at 8480 +/- 70 BP (the first level in LPAZ Cci). As *Corylus* pollen values rose during the latter half of LPAZ Cb *Betula* pollen values declined. By 8480 +/- 70 BP *Corylus* is considered to have replaced *Betula* as the dominant arboreal taxon (see figure 41), a change that reflects its ability to out-compete *Betula* on better quality soils (Grime *et al.* 1988). The possible areas in which this displacement may have occurred is discussed in Chapter Eight.

The date of the *Corylus* rise at Cruvie is based on the assumption of a constant sedimentation rate between the dated horizons at 9250 +/- 80 and 8480 +/- 70 BP. The interpolated date of ca. 8910 BP places Cruvie at the margins of the 9000 BP isochrone defined by Birks (1989). A range of dates relating to the *Corylus* rise has been recorded and published from sites in Fife. These dates are shown in table 14 below:

Table 14 The timing of the *Corylus* rise within the study area.

Date	Site	Author
9350 +/- 70 BP	Pickletillem	Whittington *et al.* 1991
ca. 9000 BP	Black Loch	Whittington *et al.* 1990
8449 +/- 85 BP	Creich Castle	Whittington *et al.* 1990

The position of the sites and the timing of the *Corylus* rises suggest that hazel may have been progressively colonising the area of Fife from a south-easterly direction (see Chapter 8:2). The date recorded for the *Corylus* rise at Creich Castle is considerably later than that recorded at the other local sites and it is suggested that as this site experienced a number of dating problems (Whittington *et al.* 1990) it should be viewed with caution.

As the birch/hazel woodland became established there was an apparent decrease in the amount of open ground. This reduction is indicated by the marked falls recorded in the representation of Gramineae pollen, Ericaceae pollen and Filicales spores during the second part of LPAZ Cb. It is recognised that the establishment of a woodland canopy would have resulted in a reduction in the representation of pollen taxa from other sources. However, the presence of a range of herbaceous taxa (representative of the woodland ground layer) suggests that the record was reflecting a genuine decline in heath land areas. The continued presence of *Salix* and Cyperaceae pollen is interpreted as indicating the presence of wet areas close to the site throughout this period.

The *Corylus* rise occurs synchronously with an apparent fall in water-levels. *Typha* disappears from the pollen record and for a brief period at 8480 +/- 70 BP no aquatic taxa are recorded. This change may have permitted *Corylus* to encroach into areas previously dominated by the more moisture-tolerant *Betula*, and once established to become dominant.

Other features of this LPAZ included the first intermittent occurrence of single grains of *Quercus* and *Ulmus* pollen at 8480 +/- 70 BP These grains are not considered to indicate local populations but are attributed to long-distance wind transportation. *Pinus* continues to be fairly strongly represented between 9250 +/- 80 and 8480 +/- 70 BP, and only minor variations in concentrations of *Pinus* pollen are recorded between LPAZs Ca and Cb (see figure 39). It is suggested that the *Pinus* pollen in LPAZ Ca may be attributed to the absence of other taxa, and that the relatively stable levels of *Pinus* pollen recorded reflect consistent input from a distant but established area of pine.

The *Pinus* values of 5 to 10% recorded during LPAZ Cb were below the 20 % considered by Bennett (1984) to indicate a local pine population. However, similar values of 8 % *Pinus* were recorded at Black Loch (Whittington *et al.* 1990) before 8000 BP, at a time when the site was already supporting a well established deciduous woodland. Whittington *et al.* (1990) suggested that "In that area are widespread deposits of fluvioglacial sands and gravels which edaphically would have been more suited to the growth of pine than deciduous trees." (1990 p.41).

It is suggested that the source of the relatively high *Pinus* pollen values recorded at Cruvie during this corresponding period may include isolated stands of pine growing on soils formed upon fluvioglacial sands and gravels and that given the close proximity of the two sites, approximately 17.5 km, it may be reasonable to assume pollen input from a shared source area, although the location of this source area remains unclear.

5:6:2 - The early to mid - Holocene (ca. 8480 to 5130 BP).

The period between ca. 8480 and 7630 BP (LPAZ Cci) was characterised by a mixed birch / hazel woodland. The generally low values for Gramineae, Filicales and herbaceous pollen taxa (figure 42) are considered to indicate a closed woodland canopy. The aquatic pollen taxa *Nuphar*, *Callitriche* and *Typha* are all present (in low concentrations) in LPAZ Cci, suggesting the presence of a body of water absent at the end of LPAZ Cb. It is suggested that this may have reflected a rise in the water-table.

During LPAZ Cci a percentage decline in *Corylus* pollen and a synchronous increase in herbaceous pollen taxa (in particular Gramineae) was recorded. A rise in the water-table may have placed stress on the local hazel population, leading to a decline in pollen productivity. A fall in the pollen productivity of one of the main arboreal species would have produced an increase in the representation of pollen from the ground-layer community. It is considered that the changes recorded in LPAZ Cci reflect variations in the pollen productivity of *Corylus* rather than a change in woodland composition, particularly as no substantial alterations are recorded in the values of other arboreal taxa during this period.

The start of LPAZ Ccii is marked by the arrival of *Ulmus* at ca. 7650 BP. Birks (1989) isochrone map places the rational limit for *Ulmus* in eastern Scotland at between 8500 and 9000 BP. Within Fife this event has been dated at 8470 +/- 60 BP (Pickletillem - Whittington *et al.* 1991) and ca. 8500 BP (Black Loch - Whittington *et al.* 1990). As these sites are located within 20 km of each other, in a lowland area subject to the same climatic conditions and underlain by sands and gravels, soil development might be expected to have progressed at a similar rate at all three sites, resulting in similar rates of arboreal colonisation and expansion. On the basis of the available data it is unclear why the colonisation of the Cruvie catchment occurred approximately 850 years after *Ulmus* became established in other parts of Fife. The late arrival of *Ulmus* continues the trend set by *Betula*.

During LPAZ Ccii (ca. 7010 to 7630 BP) a marked decline in *Corylus* pollen values is recorded, a continuation of the trend recorded in LPAZ Cci. It was initially thought that a rise in the water-table may have been responsible for this change. However, the validity of this argument was thrown into doubt by the absence of aquatic taxa from the palynological record in LPAZ Ccii, and the increases in the representation of Cyperaceae, Filicales and Gramineae. It is suggested that these changes may represent a phase of increased dryness, during which some areas of the site appear to have become dry enough to be colonised by opportunistic Gramineae and ferns, whilst a core area remained sufficiently wet to support a sedge community. The continued decline of *Corylus* pollen during LPAZ Ccii may in part reflect the increased representation of *Ulmus* during this period. As *Ulmus* became established as a canopy tree the levels of pollen reaching the coring site from *Corylus* located in the understorey layer of the woodland would have been reduced, owing to increased pollen filtration by the canopy, possibly producing a reduction of the type recorded in LPAZ Ccii.

The disappearance of aquatic taxa at ca. 7630 BP (296 cm) corresponds to an increase in overall pollen concentrations (see figure 33, 5:4); and it is suggested that sedimentation may have slowed in response to drier conditions during this period. Alternatively the higher concentrations recorded could be attributed to increased pollen input during a period of increased sediment inwashing. An increase in the representation of mechanically damaged pollen, particularly during LPAZ Ccii (figure 38, 5:4), suggests that sediment movement was occurring during this period.

LOI values between 296 cm and 249 cm (LPAZ Ccii) show a number of fluctuations (figure 36, 5:4), which may indicate sediment inwashing, but it is not possible to identify any exact correlations between the different lines of evidence.

The start of LPAZ Cciii marks the rational limit for *Quercus* at ca. 7010 BP. This date is considerably later than the ca. 8500 BP recorded at Black Loch (Whittington *et al.* 1990) and the date of 7880 +/- 60 BP recorded at Pickletillem (Whittington *et al.* 1991); but within the 7000 to 7500 BP isochrone proposed by Birks (1989). The late arrival of *Quercus* at Cruvie continues the pattern set by both *Ulmus* and *Betula*.

Quercus pollen values remain at less than 5 % TLP throughout the remainder of the pollen record. This was in contrast to the patterns seen at both Black Loch and Pickletillem where *Quercus* quickly became established as a dominant woodland constituent. It is suggested that the low values at Cruvie may indicate that local edaphic conditions were unfavourable to *Quercus*.

The current distribution of *Quercus* indicates that it is most commonly found on damp soils with a pH of below 5.0 and is noticeably absent from waterlogged soils and areas of grazed grass-land (Grime *et al.* 1988, p. 470). The site at Cruvie is located in a small area of waterlogged gleys (see figure 16, Chapter 1), which have a recorded pH of around 5.0 (see figure 35, 5:4). It is suggested that the combined pH and waterlogged nature of these soils may have effectively restricted the spread of *Quercus* into the area immediately adjacent to the site, and that pollen from outside the local area was largely absent from the site owing to the small pollen catchment of this site and filtration by local taxa close to the coring site (see Chapter Eight).

Between ca. 7010 and 6220 BP (LPAZ Cciii) there is a progressive change in the representation of aquatic taxa. The Ccii / Cciii LPAZ boundary is devoid of aquatic taxa indicating an absence of open water. Following this, *Sphagnum* spores are briefly recorded, before the arrival of the aquatic pollen taxon *Nymphaea* at 216 cm (ca. 6600 BP). It is considered that this sequence represents the re-establishment of an open body of water following the drier episode recorded between ca. 7010 and 7630 BP (LPAZ Ccii). The re-establishment of an aquatic community corresponds to a sharp decline in the representation of Gramineae, suggesting that the increases recorded in LPAZ Ccii do represent on-site colonisation. The strong representation of Cyperaceae during LPAZ Cciii suggests that the margins of the open water supported a thriving sedge community.

The continued presence of aquatic taxa in the remainder of the palynological record (LPAZs Cciii to Ceii inclusive) suggests that areas of open water were maintained at this site from ca. 6810 BP to 3870 BP. The changes recorded in the diversity and abundance of aquatic and semi-aquatic taxa recorded throughout this period possibly reflect changes in water-depth and nutrient balance.

During LPAZ Cciii a slight decline is recorded in the overall percentage representation of arboreal taxa (figure 42). It is considered that this change reflects a recovery in the *Corylus* population rather than a decline in arboreal taxa. An examination of the individual pollen curves (figure 41) shows that *Betula* remains the dominant arboreal taxon, with *Ulmus* also strongly represented during the first half of the LPAZ. As the increase in *Corylus* appears to have had little impact on arboreal values it is suggested that hazel was dominating the understorey layer of the predominantly birch/elm woodland; and that the high pollen values reflect open canopy conditions which allowed pollen from understorey taxa to reach the coring site. The intermittent appearance of *Alnus* pollen during LPAZ Cciii is considered to reflect either long-distance wind transportation, or the arrival of the first isolated trees in advance of the main colonisation.

Although few major changes were recorded in the overall representation of arboreal taxa during LPAZ Cciii (figure 42), fluctuations in the pollen curves of individual arboreal taxa combined with increases in the abundance and range of herbaceous taxa, including those tolerant of disturbed conditions, support the proposal that the woodland canopy was becoming more open during this period. However, the very low values of Gramineae pollen recorded suggest that any open areas were not extensive in size.

The changes outlined above might reflect natural processes, such as wind-throw, disease or the natural death of trees, within an established woodland, the increases in herbaceous taxa reflecting expansion of ground layer taxa into clearings created by the these natural events. The presence of ruderal taxa such as *Rumex*, *Ranunculus* type and *Filipendula* could reflect disturbance by grazing wild animals, such as deer. Alternatively, the changes might be reflecting human interference in the local environment, possibly relating to the creation of small clearings for the grazing of livestock, or to aid in the hunting of wild animals.

Within this context the fall in *Ulmus* values (both relative and absolute) during the second half of the LPAZ may reflect a selective use of woodland resources by a human population. Alternatively the rapid decline recorded in *Ulmus* could indicate an attack by a species-specific pathogen. This issue is addressed further in Chapter Eight. The early date recorded for the fall in *Ulmus* values during LPAZ Cciii (ca. 6400 BP) suggests that this decline does not represent the classic elm decline, which is recorded at ca. 5100 BP at many sites across Britain.

The very low Gramineae pollen values combined with the high levels of arboreal pollen recorded throughout LPAZ Cd (6220 +/- 70 to ca. 5610 BP) suggest that although the area may have been subject to some disturbance, no extensive clearances were being created. The continued presence of *Rumex* at levels of approximately 8 % TLP and the sporadic occurrence of other herbaceous taxa tolerant of disturbed conditions, including Chenopodiaceae, *Aster* type and *Artemisia*, is considered to reflect the continued presence of small openings within the general woodland canopy. The absence of any increases in the levels of microscopic charcoal during either LPAZ Ciii or Cd suggests that any disturbances were not related to either natural or anthropogenically instigated local fire events.

The start of LPAZ Cd at 6220 +/- 70 BP marks the rational limit for *Alnus* at this site (figure 39). A slow but significant increase in the representation of *Alnus* pollen is recorded throughout LPAZ Cd, culminating in a rapid increase at the start of LPAZ Cei at ca. 5610 BP. The timing of the *Alnus* rise in this area of Scotland shows considerable variation (see table 15). However, the arrival of *Alnus* at Cruvie mirrors the trend set by the other main arboreal taxa at this site, and is approximately 200 years later than at Pickletillem, the closest published site.

Table 15 The timing of the *Alnus* rise in Fife.		
Date	Site	Author
ca. 6420 BP	Pickletillem	Whittington *et al.* 1991
6500-7000 BP	Predicted isochrone	Birks 1989
ca. 7300 BP	Black Loch	Whittington *et al.* 1990

It is considered that the low *Alnus* values of LPAZ Cd represent the presence of a small local *Alnus* population rather than input from a more regional source. This conclusion is based upon the recovery of considerable quantities of wood fragments (identified as *Alnus* by Dr M. Cressey, pers. com. 1992) from core samples at this depth. The high concentration of fragments and the large size of some pieces, of up to 2.5 cm in diameter, indicates that *Alnus* was growing around the coring site at this time. The continued presence of relatively high concentrations of aquatic pollen taxa (figure x) indicates that areas of open water were also present during this period. It is suggested that *Alnus* may have been colonising the water-logged soils which the other arboreal and shrub taxa were unable to exploit successfully.

The *Alnus* expansion at the start of LPAZ Cei (ca. 5610 BP) corresponds to the start of large-scale changes in woodland composition. A comparison of the pollen concentration and percentage diagrams shows that pollen values for all arboreal taxa (excluding *Ulmus*) fell dramatically at ca. 5180 BP (104 cm). This reduction corresponds to a peak in Gramineae pollen and it is suggested that the most likely causal agent for these changes was human activity. The peak in Gramineae pollen combined with the low levels of herbaceous taxa and the absence of cereal pollen grains suggests that any agricultural activity was primarily pastoral in nature. The absence of any peaks in microscopic charcoal suggests that fire was not being used as a clearance tool in this area at this time, although the continuous presence of a small amount of microscopic charcoal may reflect small domestic fires or limited charcoal input from distant source areas.

It is considered that these changes reflect a pattern of progressive clearance, which was instigated at ca. 5390 BP and reached its greatest extent at ca. 5180 BP. The first areas to undergo modification may have been those located in the most favourable locations (in relation to edaphic conditions, slope, aspect and drainage), and this modification resulted in a general decline in arboreal pollen and the disappearance of *Quercus* from the pollen record. It is suggested that the well drained areas of Brown Earths favoured by *Quercus* (based upon its present distribution - Grime *et al.* 1988), would also be most suited to agricultural activity.

The absence of wood fragments in the core stratigraphy between 100 and 114 cm, which corresponds to a drop in the representation of *Alnus* pollen, indicates that the coring site was devoid of *Alnus* between ca. 5310 and 5130 BP. It is suggested that this absence may represent clearance of woodland in the area immediately surrounding the coring site during this period, a local clearance phase of ca. 180 years.

It is of note that *Ulmus* appears initially to have been left undisturbed. Both relative and absolute diagrams showed a peak in *Ulmus* pollen values during LPAZ Cei, suggesting that *Ulmus* was expanding during this period, or that there was an increase in the quantities of *Ulmus* pollen reaching the site due to a reduction in pollen input from other arboreal taxa. However, between ca. 5180 and 4990 BP *Ulmus* values dropped dramatically and subsequently failed to recover (figure 39). The timing of this final decline is consistent with that recorded for the classic elm decline at other sites in Fife (see table 16). Possible causes for this event are discussed in Chapter Eight.

Table 16 The timing of the *Ulmus* decline in Fife.

Date	Site	Author
5180 +/- 80 BP	Black Loch	Whittington *et al.* 1990
ca. 5100 BP	Pickletillem	Whittington *et al.* 1991

5:6:3 - The mid to late Holocene (ca. 4990 to 3870 BP).

The final LPAZ at Cruvie (Ceii - ca. 4990 to 3870 BP) is dominated by *Alnus* pollen. The presence of fragments of *Alnus* macrofossils in the stratigraphic record was interpreted as indicating the recolonisation of the coring area by *Alnus*. The close proximity of *Alnus* probably produced a masking effect in the pollen record, making it difficult to assess the possible extent of human interference on the surrounding dry land. It is suggested that the fluctuations in arboreal pollen values which correspond to continued high values for *Rumex* and the sporadic occurrence of other herbaceous taxa (including *Filipendula*, *Artemisia*, *Aster* type and *Plantago media / major*), all of which are indicative of open but disturbed conditions, could indicate that the area was being exploited by a human population during the Neolithic period.

The re-establishment of *Alnus* around the coring site suggested either that levels of exploitation were not as extensive during LPAZ Ceii, or that this part of the catchment ceased to be a focus of activity after LPAZ Cei, allowing localised regeneration. It is of note that arboreal taxa (excluding *Alnus*) failed to regain the values (absolute or relative) achieved prior to ca. 5390 BP This suggests that although the nature and level of human activity in this area is difficult to assess

(due to *Alnus*'s local presence) after the initial phase of woodland clearance during LPAZ Cci there continued to be activity on a level sufficient to prevent any major woodland regeneration.

The absence of cereal pollen grains could be interpreted as indicating that this area was used primarily for pastoral activity. Alternatively the absence of cereal pollen could reflect the low levels of pollen productivity and highly localised distribution patterns associated with this taxon. The absence of cereal pollen does not conclusively rule out the possibility of arable agriculture.

A fall in the representation of *Corylus* and *Alnus* pollen and an increase in Filicales spores and Gramineae pollen (both relative and absolute) was recorded between ca. 4350 and 3870 BP (40 cm to 0 cm). These changes correspond to a decline in the concentrations of aquatic taxa, suggesting a fall in water-levels, and may reflect a period of increased dryness, during which the site was colonised by opportunistic grasses and ferns. Alternatively, increased sediment input might reflect the inwash of material due to local land clearance by a human population, creating the slight reductions in *Corylus* and *Alnus* and a similar reduction in water-levels. The increased representation of mineral matter in sediments from this period (figure 36, 5:4) suggests that sediment inwash was occurring; whilst an increase in both mechanically and chemically damaged pollen (figure 38, 5:4) appears to indicate both secondary pollen transportation and oxidation / biological activity. On the basis of this evidence it is suggested that sediment inwashing, possibly combined with drier climatic conditions, allowed colonisation of the site by terrestrial plant taxa.

The termination of the pollen record at approximately 3870 BP indicates that a considerable depth of material is missing from this site. It is considered unlikely that the site dried to such an extent that all deposition ceased, as the site occupies the lowest point within a closed basin and continues to exist as a lake site to the present day. A more likely explanation would be the removal of peat from the site by humans. The presence of Cruvie Castle (dating from the medieval period) at the edge of the catchment area lends support to the idea that deposits were removed for use as fuel, or as an organic soil conditioner for the sandy soils in the area.

Chapter Six - The palaeoenvironmental record at Pitbladdo

6:1 - Introduction

The sediments examined from Pitbladdo cover the period from approximately 8100 to 3900 years BP (section 6:2) and provide a detailed palaeoenvironmental record for most of the Holocene. The rapid sediment accumulation rate of 0.15 cm yr^{-1} (average for core) has allowed the recognition of biostratigraphic events of short duration not distinguishable in deposits that are either more compressed or have a slower accumulation rate. The sedimentological data are presented in figures 44 to 49 and tables 17 and 18. Pollen data are presented in figures 50 to 55 located in the folder at the back of this volume. Summary diagrams figures 56 and 57 are located at the end of section 6:5. The raw data used in the production of these figures and tables are presented in Volume Two, Appendix Two.

6:2 - Radiocarbon dates.

Eight radiocarbon assays were obtained on material from Pitbladdo (table 17). These dates form the chronological framework for the site and are used in the calculation of the time-depth curve (figure 43) and pollen influx rates (figure 44). All dates are expressed as uncalibrated years BP.

Table 17 details of the radiocarbon assays for Pitbladdo.

Laboratory number	Mean depth (cm)	Sediment thickness (cm)	Fraction	^{14}C age BP	1σ	$\delta^{13}C$ ‰	Calibrated age range BC (1σ)
GU4093	64	63-65	Humin and Humic	4070	100	-27.5	2873-2480 BC
GU4031	124	123-125	Humin and Humic	4230	90	-27.9	2919-2667 BC
GU4032	217	216-218	Humin and Humic	4610	90	-30.2	3505-3142 BC
GU4033	331	330-332	Humin and Humic	5240	90	-30.5	4228-3983 BC
GU4034	347	346-348	Humin and Humic	5530	130	-31.2	4500-4245 BC
GU4035	379	378-380	Humin and Humic	6150	100	-31.8	5230-4940 BC
GU4036	429	428-430	Humin and Humic	7210	140	-31.4	6170-5960 BC
GU4037	469	468-470	Humin and Humic	7840	110	-31.2	7014-6498 BC

6:3 - Sediment stratigraphy.

Coring at this site recovered 479 cm of organic deposit, a depth comparable to the 474 cm recovered at Cruvie (see Chapter Five). The stratigraphy of the sampled column is shown in figure 45 and table 18. The site at Pitbladdo is underlain by inorganic silty sands, part of the extensive till deposits that cover this area of Fife. Overlying these deposits are 10 cm of pale grey silty clays 489 cm (ca. 8120 BP) to 479 cm (ca. 7990 BP). A sharp boundary between the clays and a dark brown silty mud was recorded at 479 cm, with a further sharp transition to an organic silt recorded at 39 cm (ca. 4000 BP). The upper 19 cm of the organic silt contained roots extending from present surface vegetation.

Figure **43** Time–depth curve for sediments from Pitbladdo.

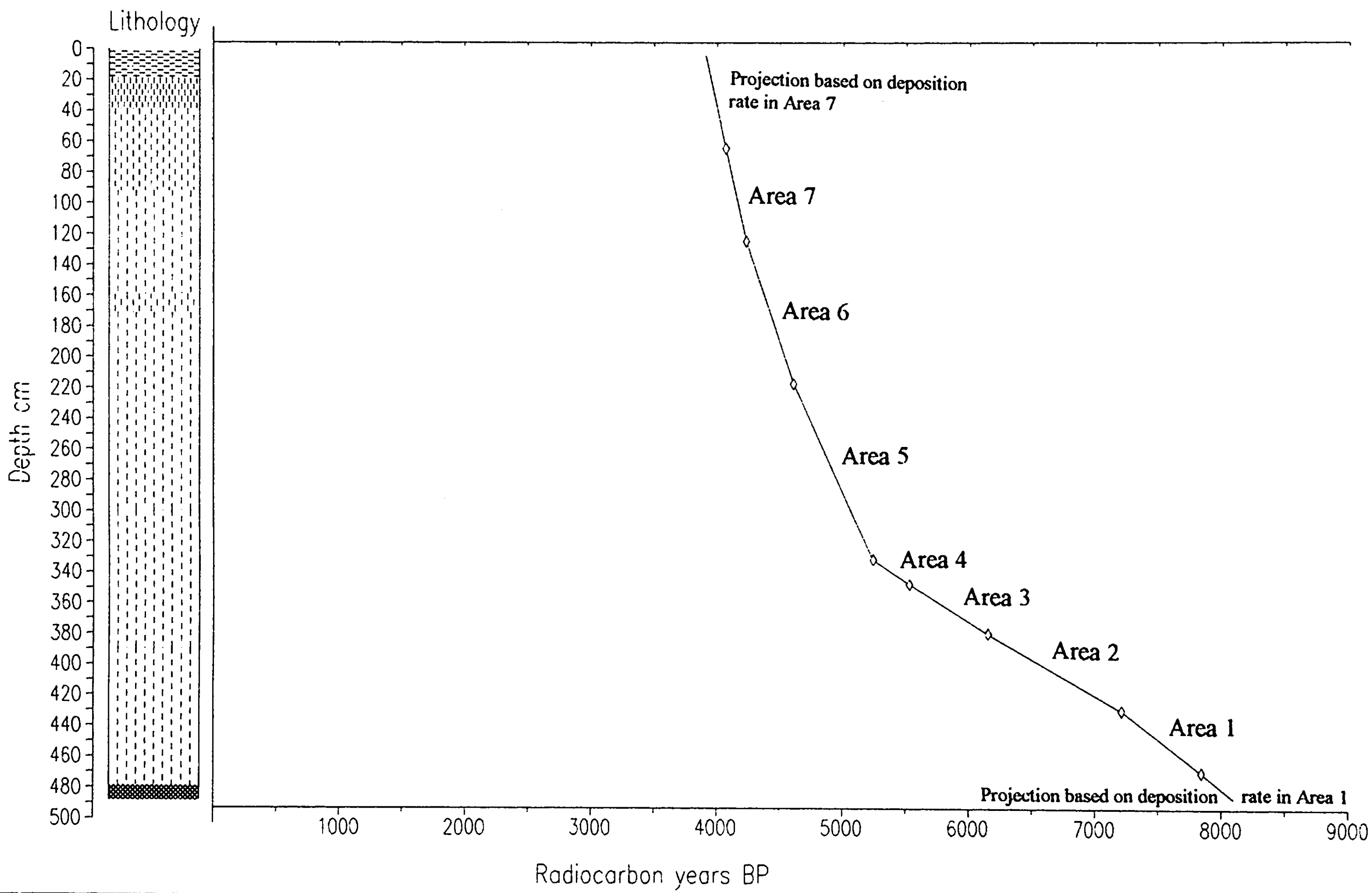


Figure 4.4 Concentration, grains cm^{-3} wet sediment x 10^3 and Influx, grains/cm/year for Pitbladdo.

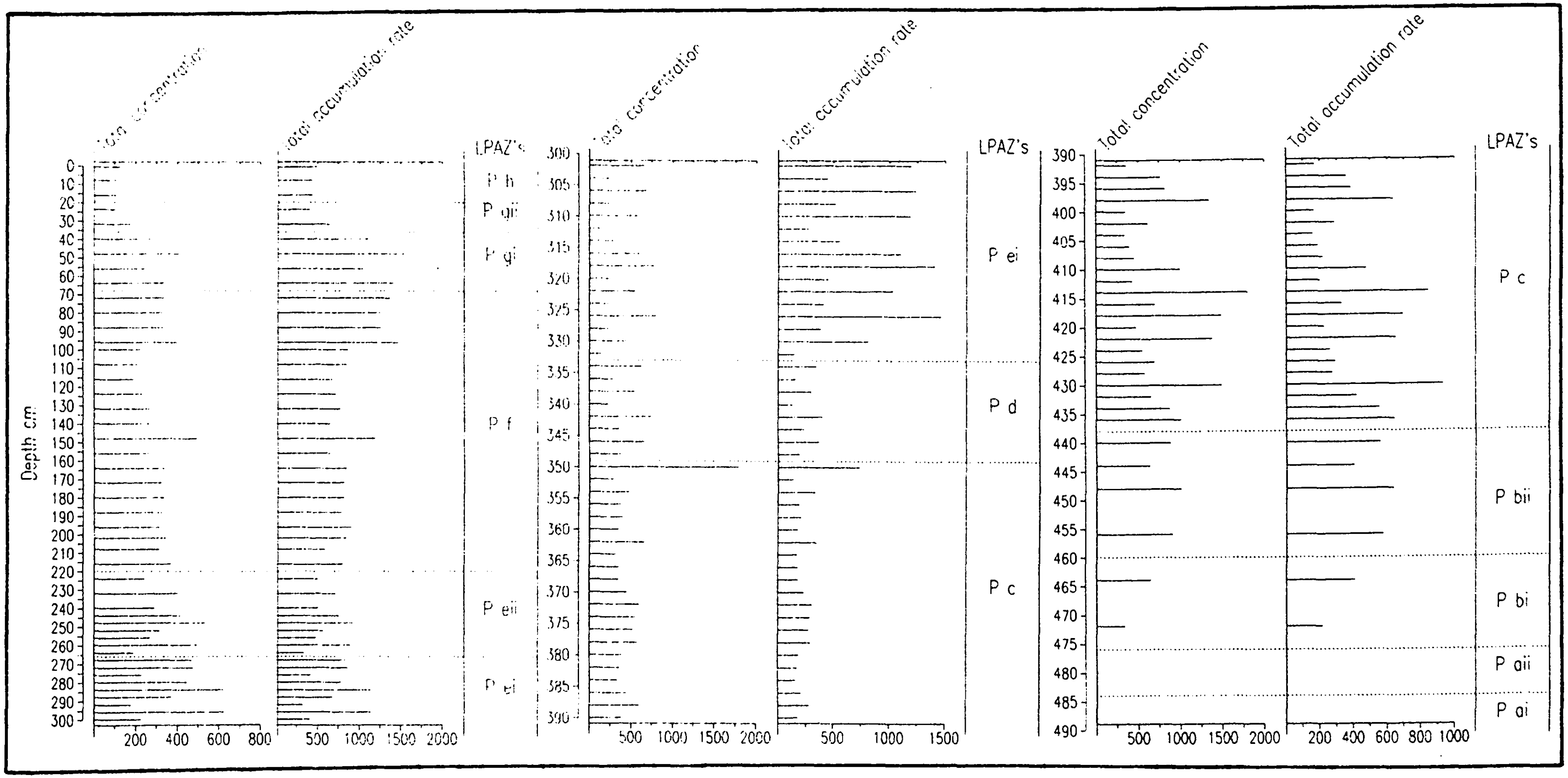


Table 18 showing the sediment stratigraphy recorded at Pitbladdo.

Depth in cm	Sediment type
0 - 19	Organic silt containing modern roots, gradual transition to
19 - 39	Amorphous organic silt, sharp transition to
39 - 92	Dark brown amorphous silt / mud, gradual transition to
92 - 159	Mid - brown amorphous silt / mud, gradual transition to
159 - 171	Dark brown amorphous silt / mud, gradual transition to
171 - 479	Mid - brown amorphous silt / mud, sharp transition to
479 - 488	Pale grey silty clay gradual transition to.
489 - 500	Red silty sands (Till deposits underlying organic sequence).

6:4 - Sedimentary record.

This section outlines the main features of the sedimentary record at Pitbladdo. The sedimentary data obtained from Pitbladdo include pH, loss on ignition, magnetic susceptibility, pollen preservation, pollen concentration and sediment deposition rates and are summarised in Figures 44 to 49. The primary data used in the production of these figures are presented in Volume Two Appendix Two.

The pH values recorded at Pitbladdo (figure 46) range between 3.1 and 6.3, indicating that the status of the sediments ranges from highly acidic to almost neutral. The silts and sands at the base of the core (488 to 500 cm) have a pH of 6.3 (the highest recorded at this site), indicating that the Till deposits underlying the site have an almost neutral chemical status. The pH of the grey clays overlying the Till deposits (479 to 488 cm) range between 3.1 and 3.6 (the lowest values recorded) indicating acidic conditions, whilst pH readings from the silts and muds that form the dominant sediment type at this site (0 to 479 cm) fluctuate between 4.0 and 5.5 indicating acidic conditions, similar to those recorded at Cruvie (see Chapter Five).

Loss-on-ignition readings from Pitbladdo range from 3 % to 92 % organic matter (figure 47). Increases in mineral matter appear as troughs in organic matter in figure 47. The lowest values were recorded from the basal silt/clay, which contain only a limited amount of organic material (3 % to 6 %), suggesting that these deposits formed in an environment supporting little vegetation. The overlying silts/muds contain a greater amount of organic material, with values fluctuating between 66 % at 52 cm (ca. 4040 BP) and 92 % between 20 cm and 28 cm (ca. 3960 and ca. 3980 BP); a mean of 78 % organic matter was recorded over the entire core.

Figure 47 shows that periodic increases in mineral matter occur throughout the core. These increases are similar in character, but on a larger scale, to those recorded at Cruvie, with a gradual increase in the representation of mineral matter occurring over several levels before an abrupt decline. Several minor peaks in mineral material occur within the lower half of the Pitbladdo core;

Figure 4.5 Lithology for Pitbladdo

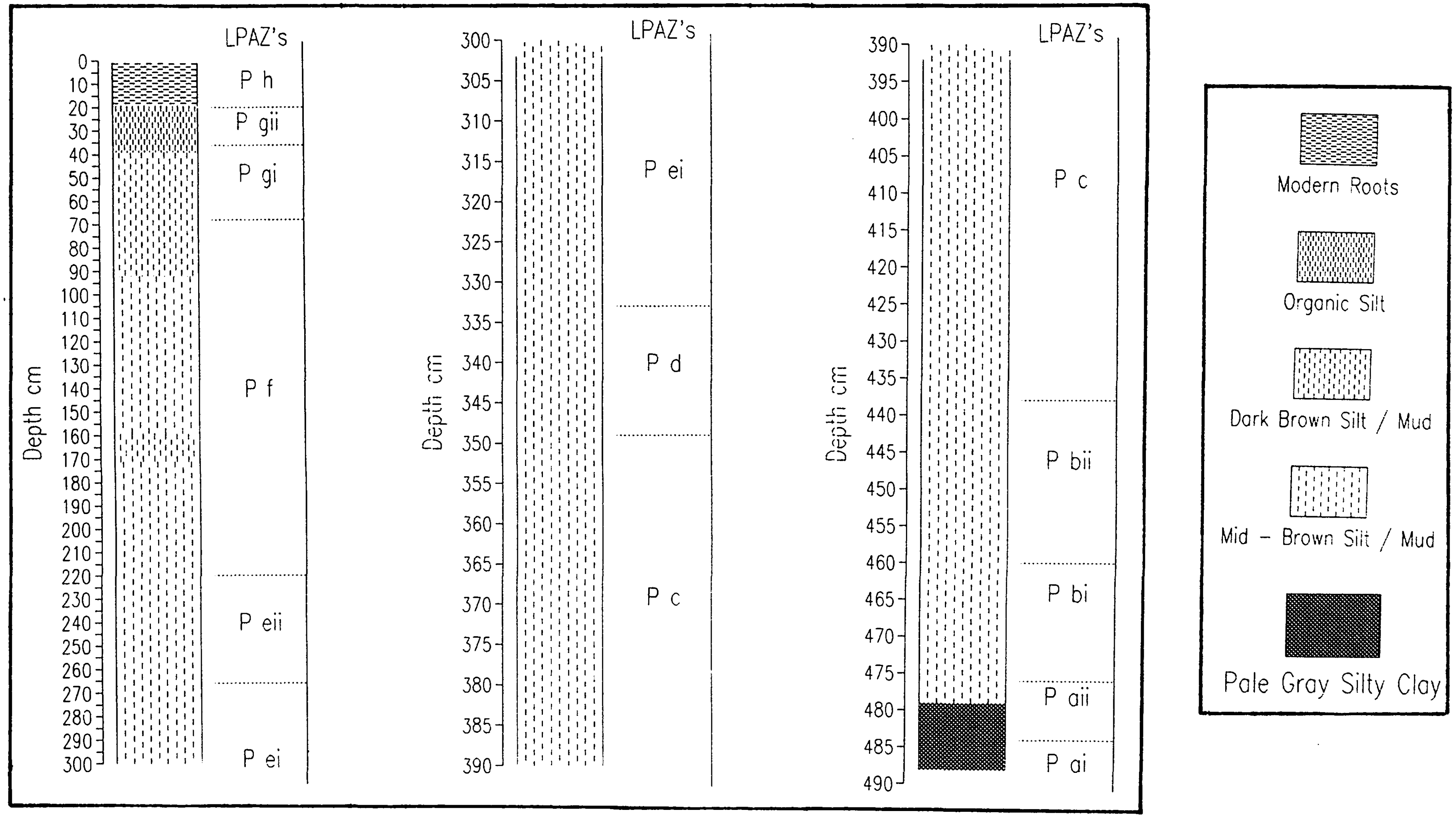


Figure 46pH diagram for Pitbladdo.

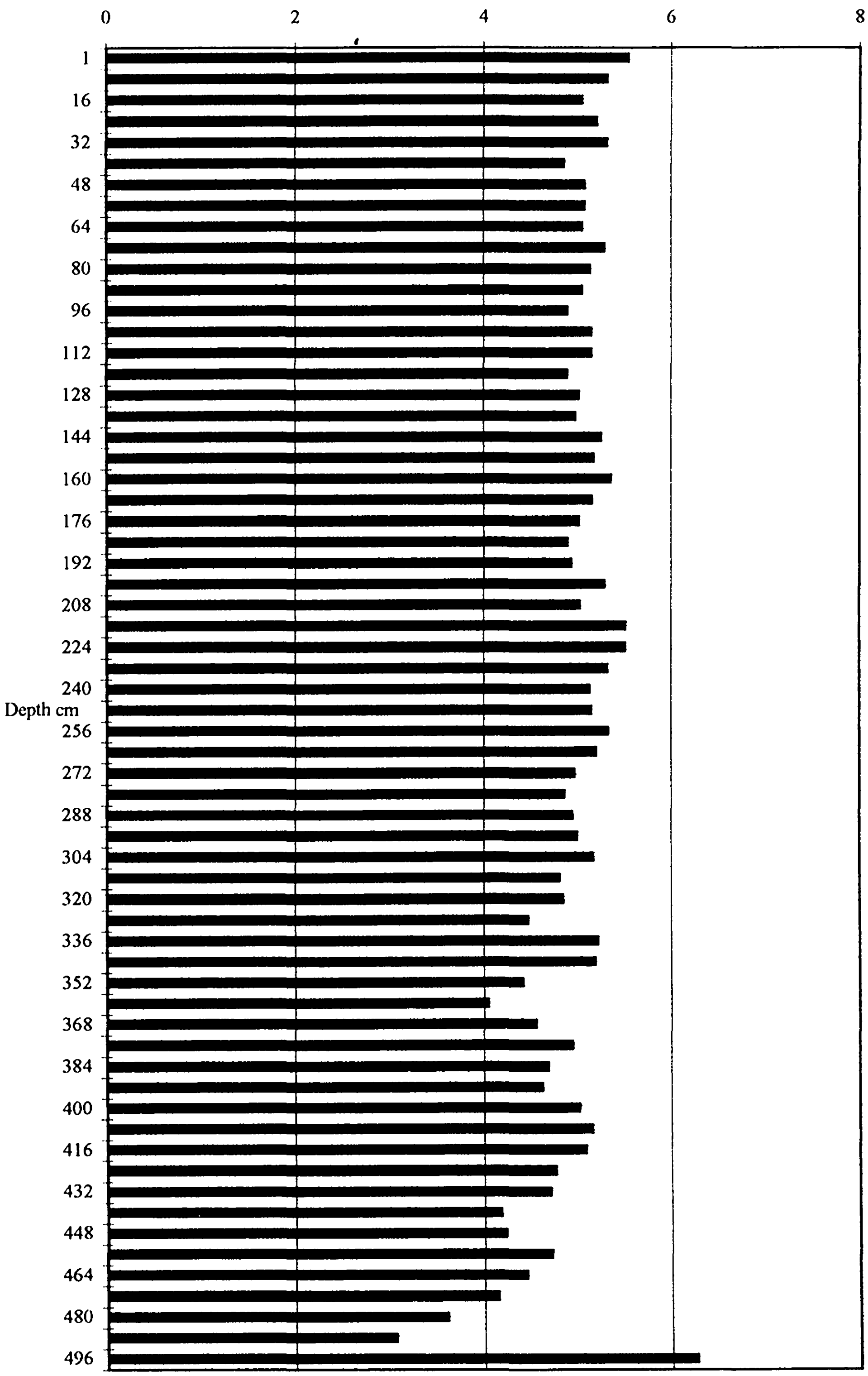
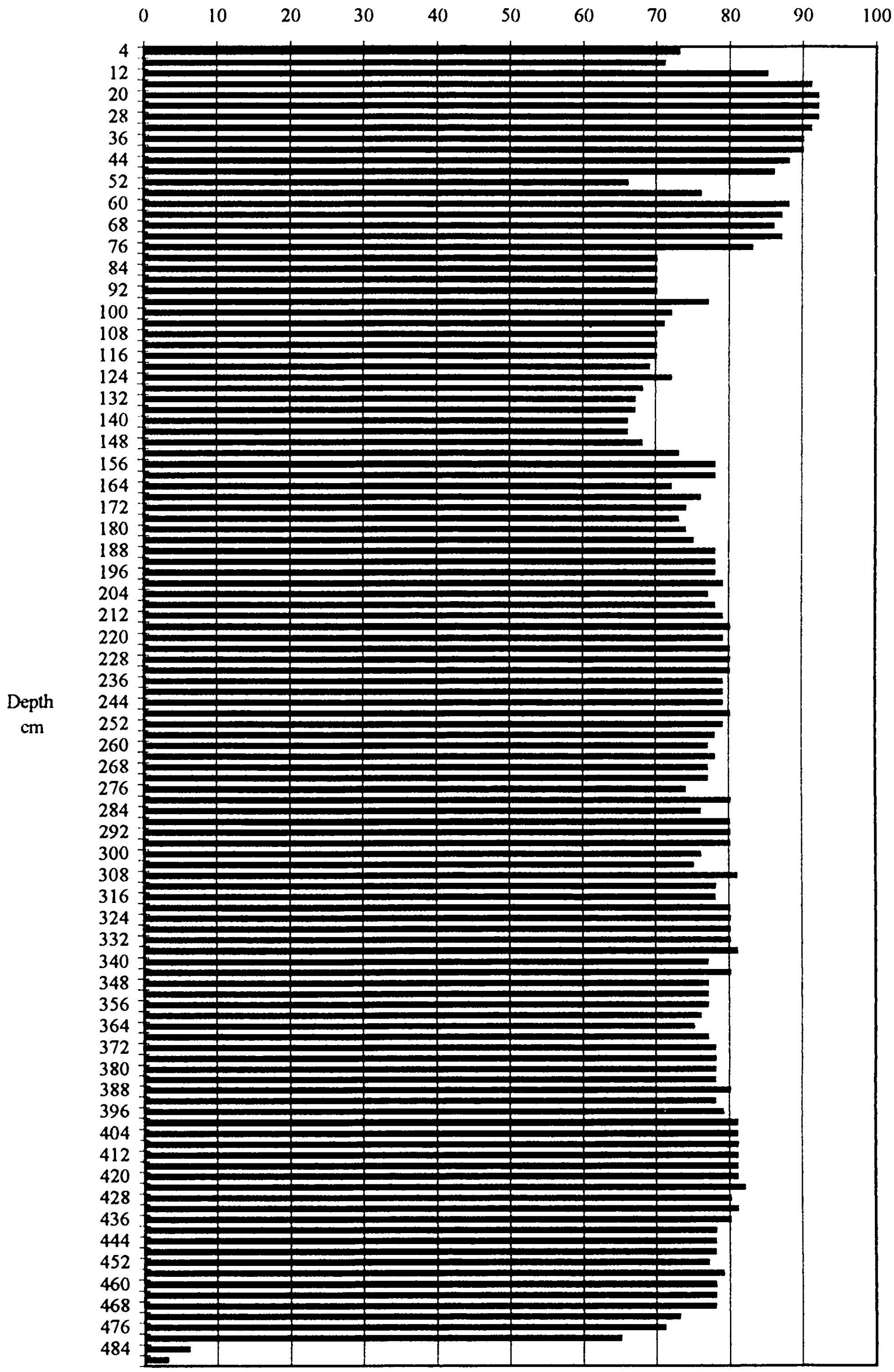


Figure 47 Loss on ignition for Pitbladdo.



however, the main increases all occur in the period following ca. 4610 BP (216 cm), including peaks of 28 % to 34 % between 148 cm and 80 cm (ca. 4320 to 4110 BP), an isolated peak of 34 % at 52 cm (ca. 4040 BP) and a further peak of 27 % to 29 % between 8 cm and 4 cm (ca. 3920 to 3910 BP).

On the basis of the available data it is not considered possible to identify with any degree of certainty the cause or causes of these episodes of increased sediment input. However, it is suggested that these increases might reflect periods of anthropogenically instigated soil instability and may be linked to woodland clearance and agricultural activity. The major phases of increased mineral material all occur within the Neolithic and later periods, when increasing human activity might be expected to have had an increasing impact upon the sedimentary record.

Magnetic susceptibility readings from Pitbladdo (figure 48) mirror the results recorded at Cruvie (section 5:4). The organic sediments that form the bulk of the sediment record contain no magnetic minerals and the increases in mineral matter recorded using LOI were not detected by magnetic susceptibility, indicating a lack of magnetic minerals in the source material, a feature common to many of the fluvio-glacial sands and gravels of this region (Coles, pers. com.). The silty clays and sands (479 cm to 500 cm) and the initial 9 cm (470 cm to 479 cm) of the overlying silts/muds recorded positive readings of 0.2 to 0.3 and 0.1 respectively, indicating the presence of small quantities of magnetic minerals in the basal sediments at this site.

Pollen recovered from the basal sediments at Pitbladdo (figure 49) include a high percentage (64 %) of mechanically damaged grains. It is suggested that pollen recovered from these mainly inorganic sediments may have had a secondary source and been damaged during transportation. Pollen preservation throughout the rest of the core (figure 49) is variable with normal (well preserved) pollen accounting for between 41 % and 84 % of the pollen sum. The changes in pollen preservation recorded indicate variations in depositional conditions.

In the period between ca. 8000 to 7310 BP (480 cm to 436 cm) corroded pollen grains represent less than 15 % of total land pollen. However, in the period from ca. 7270 BP (434 cm) to ca. 5060 BP (300 cm) corroded grains consistently form more than 15 % of the pollen sum. During this period the corroded pollen curve shows a pattern of regular fluctuations. On the basis of the available data it is not possible to identify a causal factor for these changes; however, it is suggested that periodic changes in levels of microbial activity or chemical oxidisation might result in concurrent changes in pollen corrosion, creating the type of patterns recorded at Pitbladdo. The presence of algal cysts and diatoms in sediments from this site suggests the possibility that these changes may be related to periodic 'algal blooms', although at present this proposal remains purely speculative.

A peak in both corroded and mechanically damaged grains is recorded between 312 cm and 296 cm (ca. 5130 and 5040 BP). This peak overlaps with an increase in mineral material recorded by LOI between 304 cm and 300 cm (figure 47), and may reflect a period of soil disturbance

Figure 48 Magnetic susceptibility for Pitbladdo.

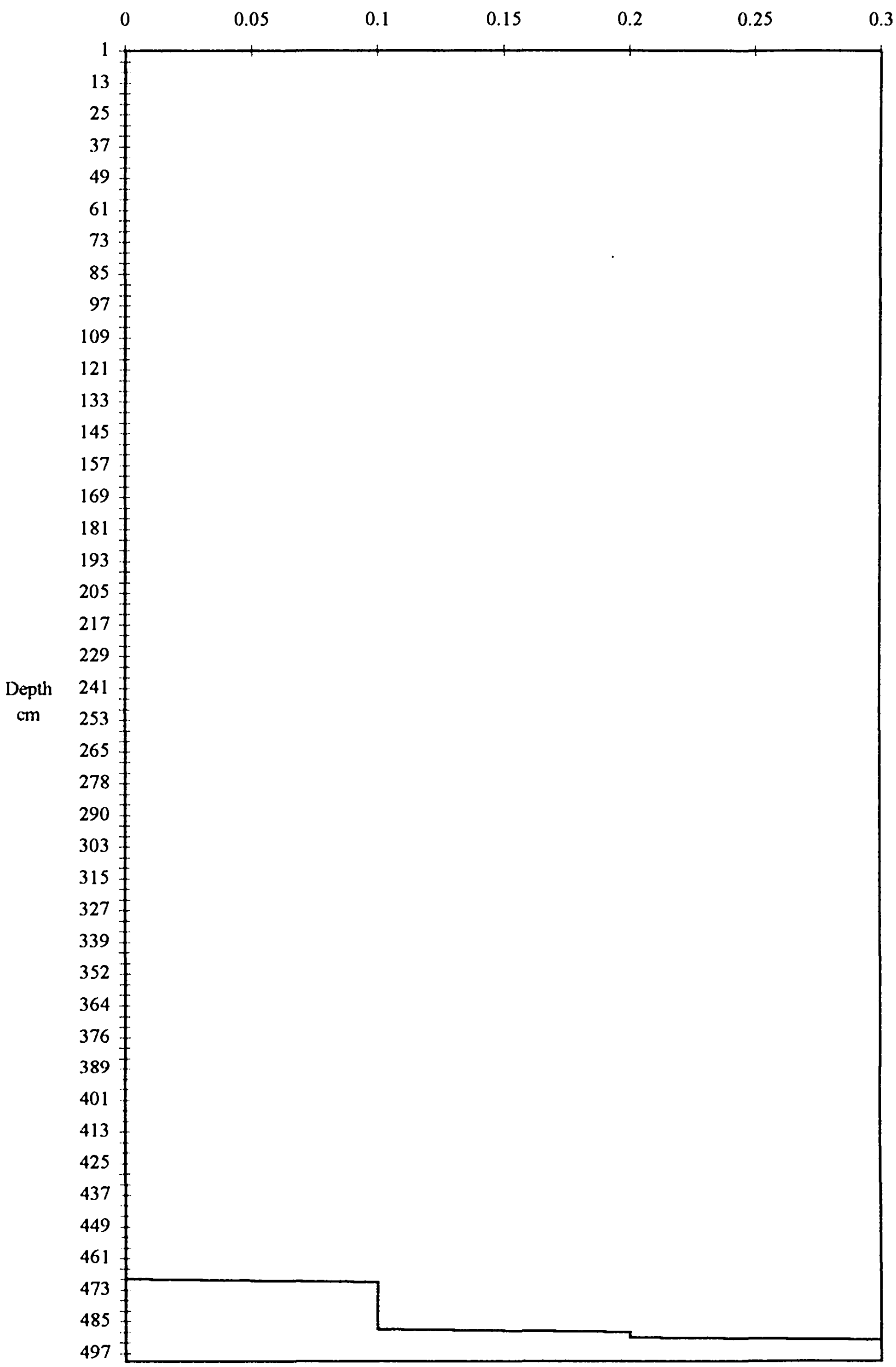


Figure 49 Pollen preservation diagram for Pitbladdo.
(a)

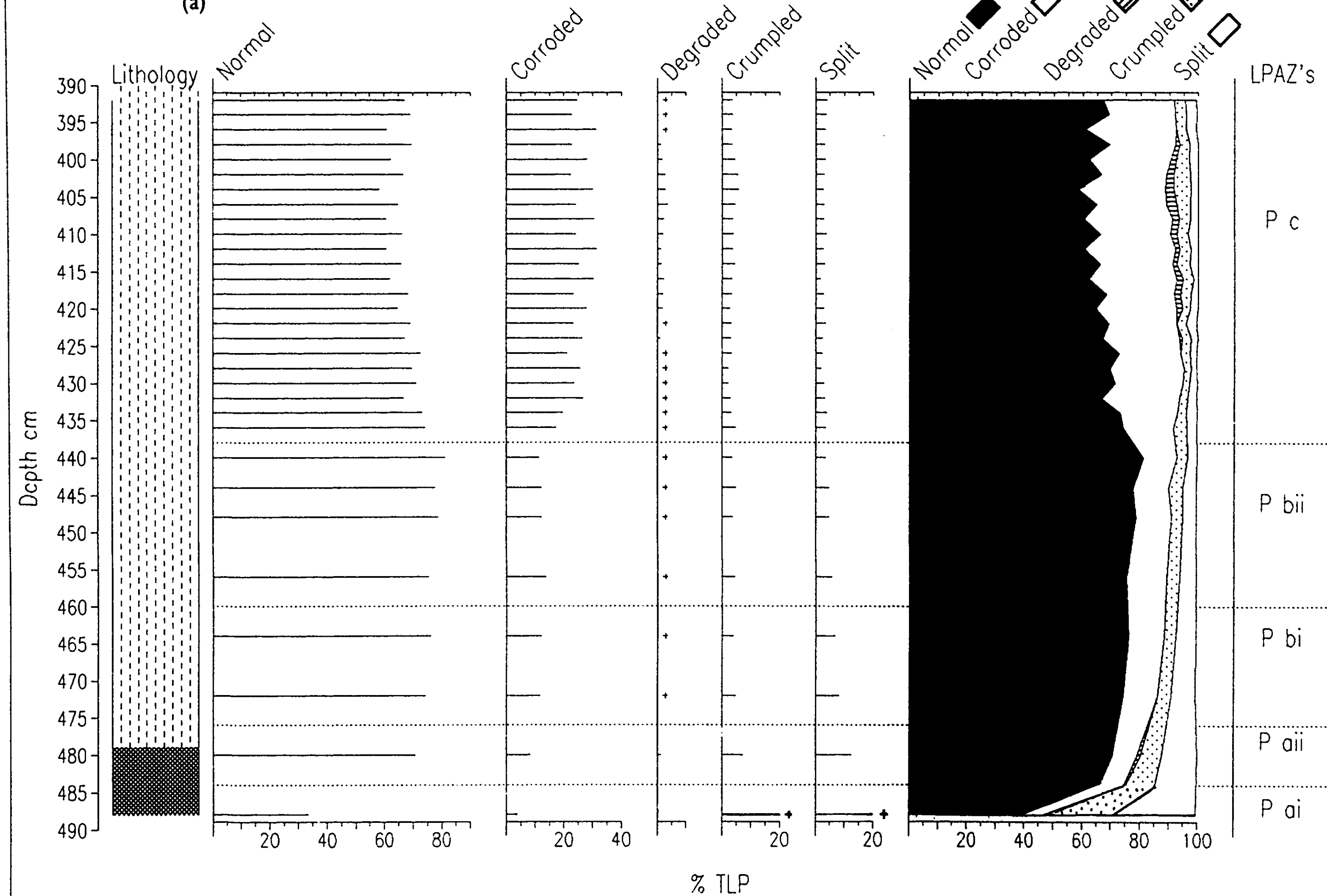


Figure 49 Pollen preservation diagram for Pitbladdo. (b)

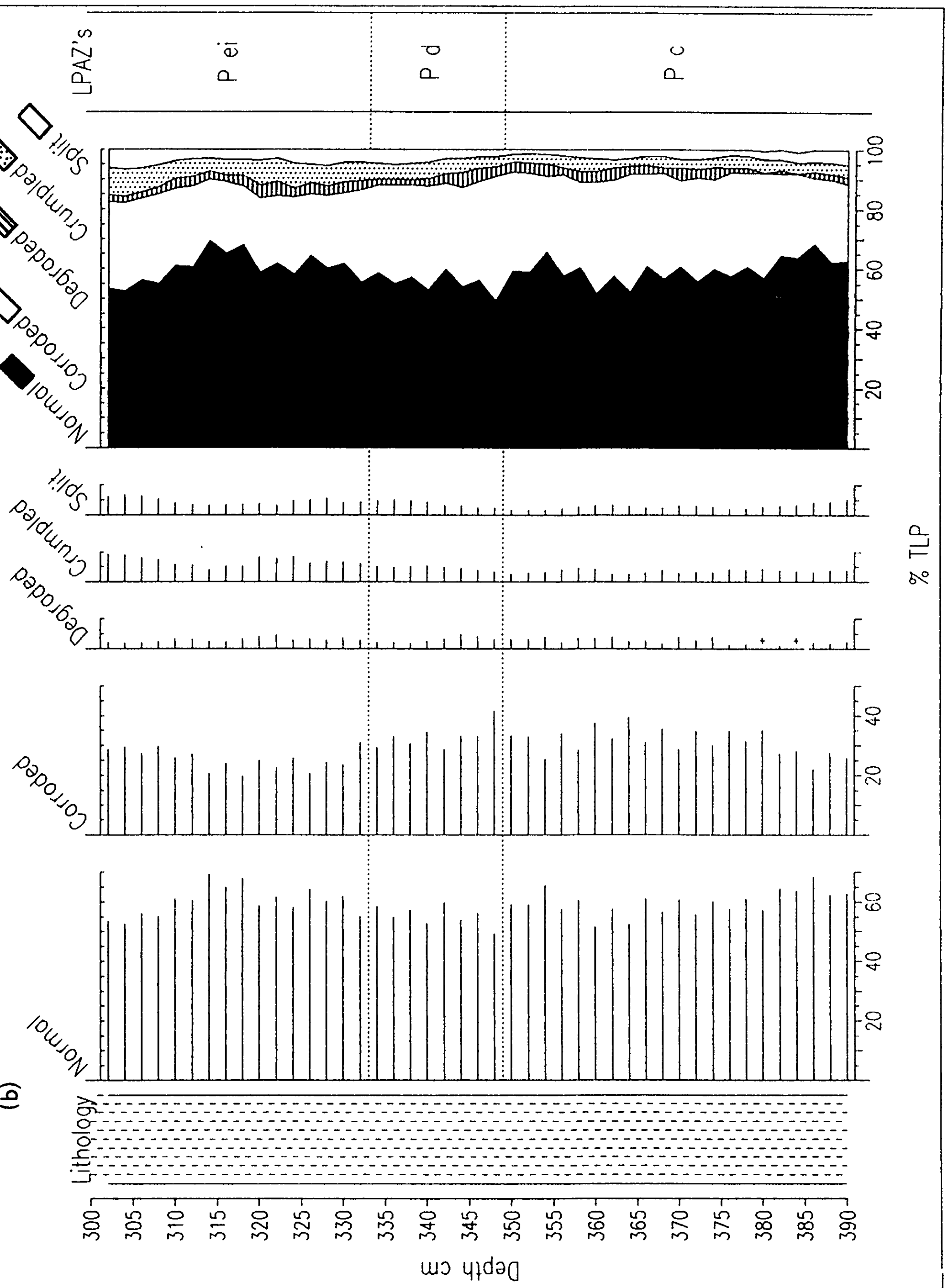
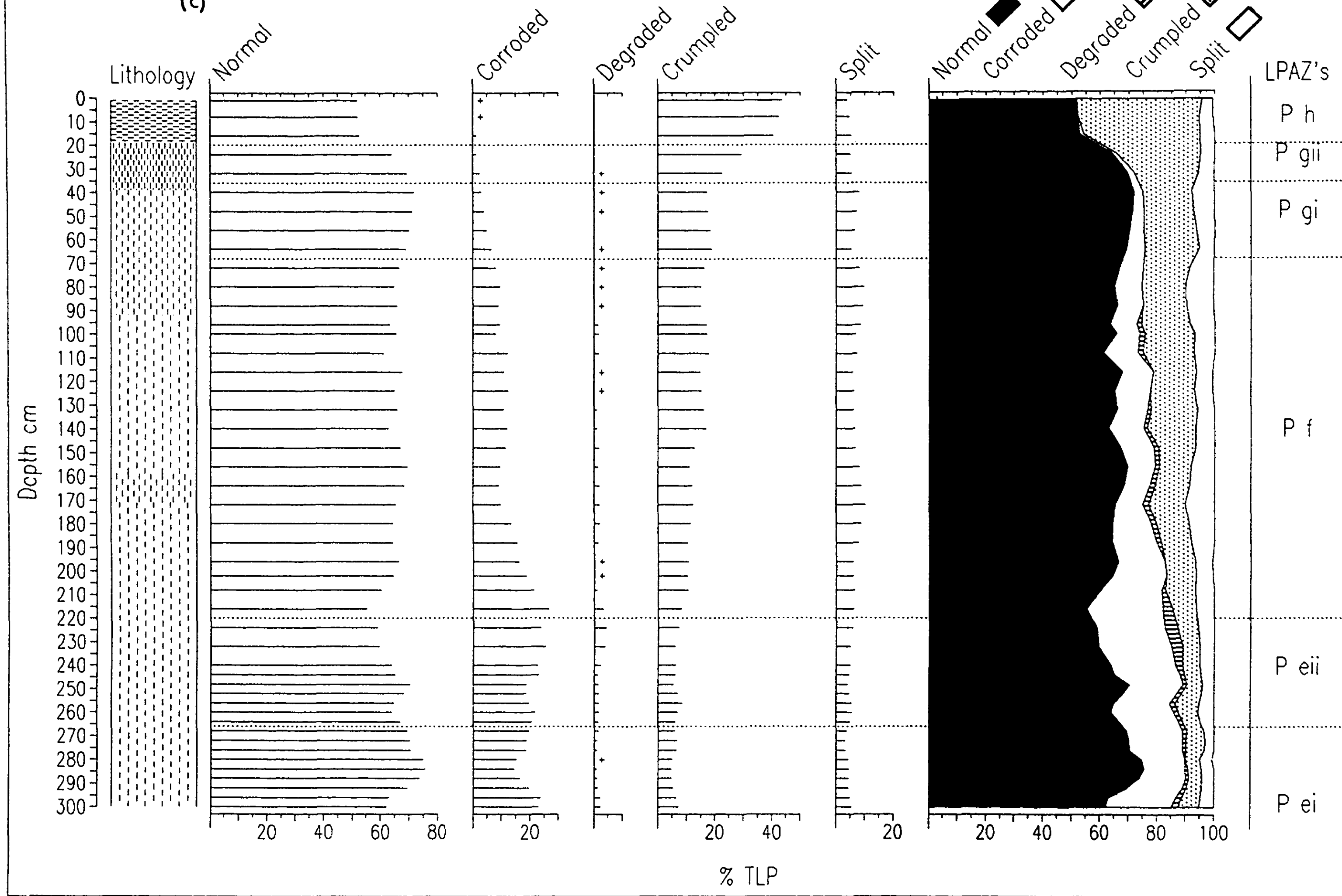


Figure 49 Pollen preservation diagram for Pitbladdo. (c)



resulting in an increase in inwashed sediment and associated pollen. Between 208 cm (ca. 4570 BP) and the top of the core at ca. 3910 BP the percentage of corroded grains recorded declines whilst the percentage of mechanically damaged grains increases. These changes fall within a period of increased mineral material (indicated by changes in LOI values - see above). The increase in mechanically damaged pollen during this period may reflect an increase in the presence of pollen inwashed from the area surrounding the coring area during sediment transportation. The decline in corroded grains is considered to reflect a fall in microbial activity and/or chemical oxidation. However, pH readings for this period show no radical changes, and the causal factors for this decline remain unclear.

The sediment deposition rates at this site (figure 43) show a greater degree of variability than those recorded at Cruvie (section 5:4), and this may in part reflect the greater number of dates obtained at this site. A deposition rate of 0.06 cm yr^{-1} is recorded at the base of the core (area 1), decreasing slightly to 0.05 cm yr^{-1} (areas 2 and 3) before a progressive increase in rates to the top of the core (0.06 cm yr^{-1} in area 4, 0.18 cm yr^{-1} in area 5, 0.24 cm yr^{-1} in area 6 and 0.38 cm yr^{-1} in area 7). The average sedimentation rate at this site is 0.15 cm yr^{-1} or 12.4 yr cm^{-1} compared with 0.09 cm yr^{-1} or 11.6 yr cm^{-1} at Cruvie. The faster deposition rates of 4.1 yr cm^{-1} recorded at Pitbladdo during the later Holocene (5240 to 3910 BP) result in a greater degree of temporal resolution at Pitbladdo during this period.

Pollen concentrations and influx rates (figure 44) calculated on the basis of sediment deposition rates show considerable fluctuations but mirror each other throughout the core. The lowest concentrations (31709 grains cm^{-3}) were recorded from the basal silty clays, and are considered to reflect both low pollen productivity by a limited number of plant species and poor pollen preservation within neutral generally inorganic sediments. The fluctuations in pollen concentrations recorded throughout the rest of the core, from a low of 114×10^3 grains cm^{-3} at 24 cm to 1493×10^3 grains cm^{-3} at 430 cm, are generally considered to reflect changes in the composition and pollen productivity of the surrounding vegetation.

6:5 - Local Pollen Assemblage Zones (LPAZs).

The pollen diagrams from Pitbladdo are divided into eleven LPAZs based on the major taxa in the percentage pollen diagram. The diagrams span the period from ca. 8100 - 3900 years BP and the dates referred to in the text are extrapolations from the time-depth curve (figure 43).

LPAZ	Depth range (cm)	Age range in uncalibrated years BP.
P h	17 - 0	3950 - 3910
P gii	33 - 17	3990 - 3950
P gi	65 - 33	4070 - 3990
P f	217 - 65	4610 - 4070
P eii	265 - 217	4860 - 4610
P ei	333 - 265	5240 - 4860
P d	349 - 333	5530 - 5240
P c	437 - 349	7310 - 5530
P bii	457 - 437	7620 - 7310
P bi	473 - 457	7870 - 7620
P a	488 - 473	8120 - 7870

LPAZ P a : 488 to 473 cm - ca. 8120 to 7870 BP.

The basal sediments contain a sparse assemblage dominated by arboreal pollen (80 % TLP at 488 cm). Low levels of *Betula*, *Ulmus* and *Tilia* pollen are all recorded, but the dominant taxon is *Pinus*, which forms 65 % TLP. The number of herbaceous taxa recorded is low. Both Gramineae and Cyperaceae are represented at low levels. *Typha* pollen and *Sphagnum* spores are both recorded at more than 1 %.

During the second half of this zone *Betula* becomes the dominant arboreal pollen taxon. *Betula* reaches its maximum of 40 % TLP, whilst *Pinus* declines from 12 % to 3 % TLP. Overall arboreal pollen levels remain stable at 38 % to 40 % TLP. Values of Gramineae and cryptogams remain low but stable whilst *Corylus* pollen values increase from 12 % to 25 % TLP. *Sphagnum* falls in value to less than 1 % TLPS.

LPAZ P bi : 473 to 457 cm - ca. 7870 to 7620 BP.

The beginning of the zone marks the start of the continuous record for both *Ulmus* and *Quercus* pollen. The zone is characterised by a decline in arboreal pollen from 40 % to 24 % TLP. A decline is recorded in *Betula* from 38 % to 14 % TLP, values of *Quercus* and *Ulmus* increase slightly, whilst *Pinus* remains stable. *Corylus* pollen values increase from 24 % to 50 % TLP during this zone. *Alnus* pollen is recorded for the first time in LPAZ Pbi and occurs sporadically at levels of less than 1 % TLP.

<u>LPAZ P bii</u> : 457 to 437 cm - ca. 7620 to 7310 BP.

During this zone *Corylus* pollen reaches its maximum of 62 % TLP at 440 cm, an event that corresponds to declines in the representation of *Betula*, *Quercus* and *Ulmus* pollen and slight increases in Cyperaceae and Ericaceae. During this period the number of both herbaceous and cryptogam palynomorphs recorded increase, and *Plantago lanceolata* pollen is recognised for the first time at this site (one level at < 1 % TLP).

<u>LPAZ P c</u> : 437 to 349 cm - ca. 7310 to 5530 BP.

This zone is characterised by the arrival (at 434 cm) and expansion (at 426 cm) of *Alnus* pollen, which becomes one of the dominant taxa, reaching peaks of 20 % TLP. The level of arboreal pollen fluctuates but overall shows a gradual increase from 25 % TLP at the base of the zone to a peak of 49 % TLP, reflecting changes in the pollen curves of individual arboreal taxa. The number of herbaceous and aquatic taxa recorded increases greatly in the first half of this zone, though percentage values remain low. *Rumex* pollen is present at all levels during this period and reaches values of 2 % TLP

During the second half of this zone the representation of Gramineae and other herbaceous pollen taxa remains consistently low, although *Urtica* pollen is recorded (sporadically at values of < 1 % TLP) for the first time at this site. A high number of aquatic taxa and spores is also recorded. Fluctuations of up to 10 % are recorded in the *Quercus* pollen curve during the second half of this zone, a pattern of change not reflected in the other arboreal curves.

<u>LPAZ P d</u> : 349 to 333 cm - ca. 5530 to 5240 BP.

This zone is characterised by two distinct declines in *Ulmus* pollen. The first decline spans four levels and records a fall in *Ulmus* values from 17 % to 3 % TLP (at 340 cm). This is followed by a recovery to 8 % TLP and a second decline spanning two levels to 1 % TLP (at 332 cm). Although other arboreal taxa fluctuate, overall arboreal values alter by only 10 % during this zone. During zone Pd, Gramineae values increase from 5 % TLP at the base to 18 % TLP by the end of the zone. Short reversals of this trend are recorded at 344 cm and 334 cm, where Gramineae values decline by 5 % TLP.

<u>LPAZ P ei</u> : 333 to 265 cm - ca. 5240 to 4860 BP.

During zone Pei, arboreal taxa constitutes between 30 and 45 % TLP. The pollen curves of individual taxa show considerable fluctuations and changes of up to 5 % TLP between adjacent levels are recorded by *Quercus*. The percentage of *Betula* pollen does not fluctuate but records a steady decline in values from 10 % TLP at 300 cm to 5 % at 268 cm. The representation of *Corylus* pollen fluctuates only slightly between 30 and 35 % TLP for the majority of the zone, but shows a slight increase between 292 cm and 268 cm with values of 40 % TLP recorded. Gramineae values change gradually during this zone and Gramineae pollen forms between 8 % and 17 % TLP. Cereal-type pollen grains (*Hordeum* type) occur sporadically at less than 1 % TLP throughout the zone.

<u>LPAZ P eii</u> : 265 to 217 cm - ca. 4860 to 4610 BP.

During this zone *Corylus* pollen values fluctuate between 25 % and 36 % TLP, whilst Gramineae values vary between 12 and 20 % TLP. The rise in Gramineae values during the first part of this zone corresponds to a decline in the values of *Corylus* pollen recorded. Overall values of arboreal taxa fall from 40 % to 30 % TLP. As in zone Pei the values of individual arboreal taxa fluctuate considerably. During this zone *Betula* records the greatest percentage changes with variations of up to 6 % TLP occurring between adjacent levels.

<u>LPAZ P f</u> : 217 to 65 cm - ca. 4610 to 4070 BP.

This LPAZ is characterised by a rise in Gramineae pollen from 19 % to 30% TLP. Overall the levels of arboreal pollen fall from 24 % to 20 % TLP. The number of herbaceous taxa recorded increases slightly and cereal-type pollen grains (*Hordeum* type) occur sporadically. Increases in the percentage representation of Cyperaceae and an increase in the representation of Ericaceae are also recorded.

<u>LPAZ P gi</u> : 65 to 33 cm - ca. 4070 to 3990 BP.

The start of LPAZ Pgi marks the last recovery in arboreal pollen at this site, and levels of arboreal pollen reach 25 % TLP (see figure 57). Peaks are recorded in both *Betula* (11 % TLP) and *Alnus* (13 % TLP) at 64 cm. These peaks are followed by an overall decline in the representation of arboreal taxa. Pollen from arboreal taxa forms only 8 % TLP at the end of this zone. The decline in arboreal pollen is mirrored by *Corylus* pollen, which records an overall decline from 19 % to 7 % TLP. Gramineae values remain generally stable at 30 % to 35 % TLP and cereal-type pollen (*Hordeum* type) is consistently recorded at less than 1 % TLP. Levels of Cyperaceae show a marked increase from 5 % TLPS at 64 cm to 18 % TLPS at 40 cm.

<u>LPAZ P gii</u> : 33 to 17 cm - ca. 3990 to 3950 BP.

This zone is characterised by high levels of Gramineae (32 % to 36 % TLP) and increasing levels of Cyperaceae (13 % - 25 % TLP). Levels of arboreal pollen remain low (< 10 % TLP), with both *Quercus* and *Ulmus* disappearing from the record. An overall increase is recorded in the number and percentage representation of herbaceous taxa. Levels of Ericaceae pollen rise to 9 % TLP during this period.

LPAZ P h : 17 to 0 cm - ca. 3950 to 3910 BP.

The start of this zone is marked by an increase in *Pinus* pollen percentages to 6 % TLP. *Pinus* values are consistently high throughout this zone. Values of other arboreal pollen taxa and *Corylus* pollen remain low at less than 5 % TLP. Gramineae values increase steadily from 33 % to 73 % TLP. The representation of Ericaceae pollen falls during this period from 8 % to < 1 % TLP, the values of Cyperaceae fall from 24 % to 7 % TLP and the number of herbaceous taxa recorded also drops slightly.

6:6 - Vegetation history.

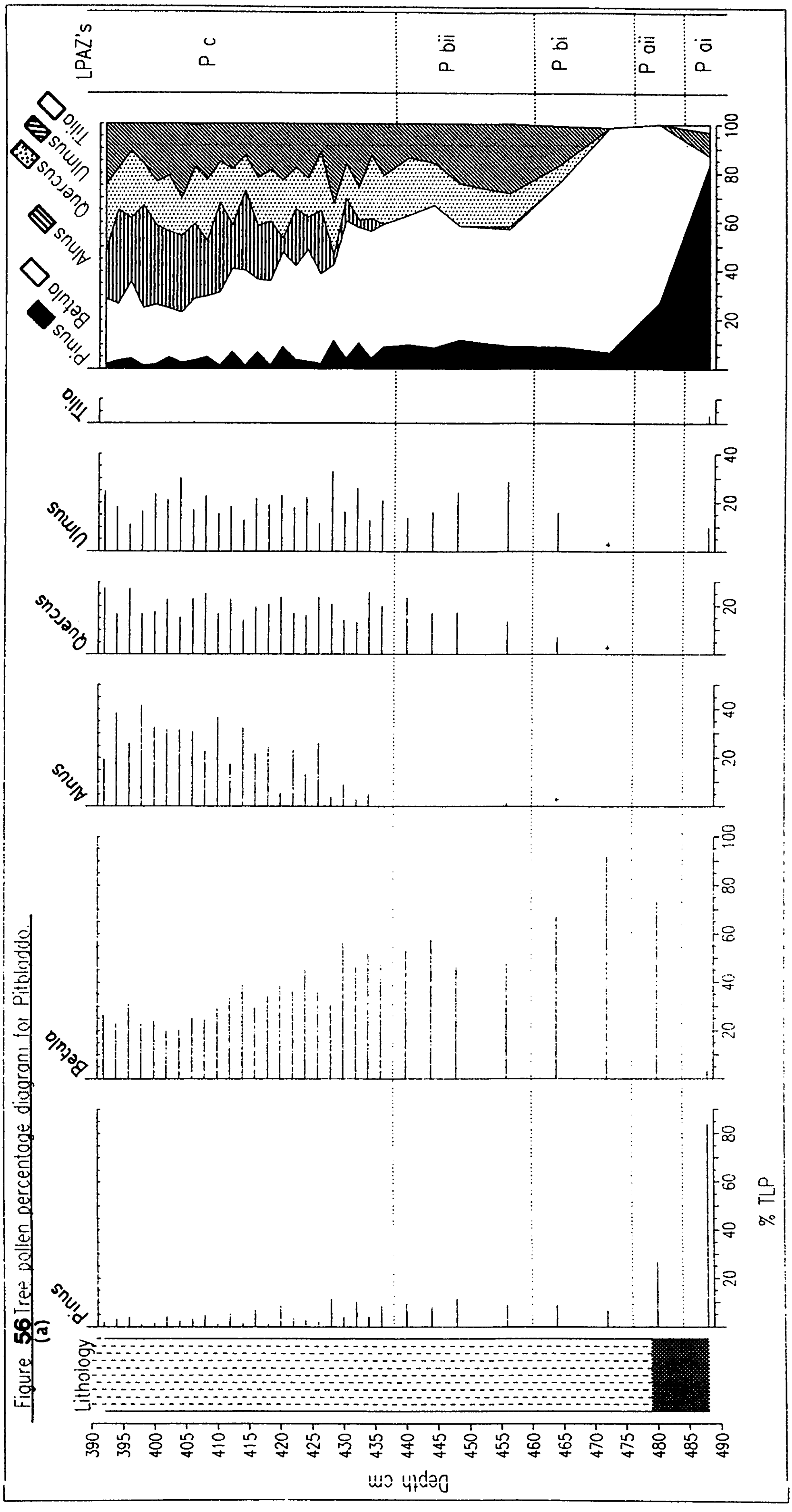
Throughout the following discussion a number of terms (after Bennett 1986a) are used to describe patterns of vegetation development as inferred from the pollen diagrams. 'Appearance' is defined as the intermittent occurrence of pollen grains of a particular taxon in the pollen record, but is not considered to indicate the presence of a local population of the taxon. 'Arrival' is defined as the first local presence of a taxon, and is recognised by the continuous presence, at low percentage values, of the pollen morphotype in the pollen record. 'Rise/expansion' is defined as an increase in the local population of a taxon, and is recognised by consecutive percentage increases in the representation of the taxon in the pollen record. 'Spread/range expansion' is defined as the movement of a taxon into and/or within a geographical area, and is recognised by variations in timing of the arrival and expansion of a given taxon in the pollen records from different locations within the study area.

6:6:1 - The early to mid - Holocene (ca. 8120 - 5530 BP).

The basal 11 cm (489 cm to 500 cm) of the sediment core recovered from Pitbladdo comprised red silty sands, overlaid by 9 cm of pale grey silty clays and 440 cm of brown silty muds. The sands that formed the base of the site were identified as part of the extensive Till deposits that cover this area of Fife and were not subjected to further analysis. The age of the basal sediments was calculated, based upon the assumption of a constant sedimentation rate between 469 cm (the oldest dated sediments) and 489 cm (the base of the clays). This calculation suggested that clay deposition began at ca. 8120 BP and that the transition between the clays and the overlying organic muds at 479 cm occurred abruptly at ca. 7970 BP.

The basal clays were characterised by very low pollen concentrations (31×10^3 to 113×10^3 grains cm^{-3}), low levels of organic matter (3 % to 6 %) and a high percentage of mechanically damaged pollen grains (64 %), whilst the pollen record contained *Pinus*, *Betula*, *Artemisia*, *Ulmus* and *Tilia*, an anomalous assemblage for the period of ca. 8000 BP. Other sites in the local area including Cruvie (section 5:5), Pickletillem (Whittington *et al.* 1991) and Black Loch (Whittington *et al.* 1990) all indicate that a mixed woodland environment dominated by *Corylus* was well established by ca. 8000 BP in this area of eastern Scotland. It is proposed that the abrupt change in

Figure 56 (a) Tree pollen percentage diagram for Pitbladdo.



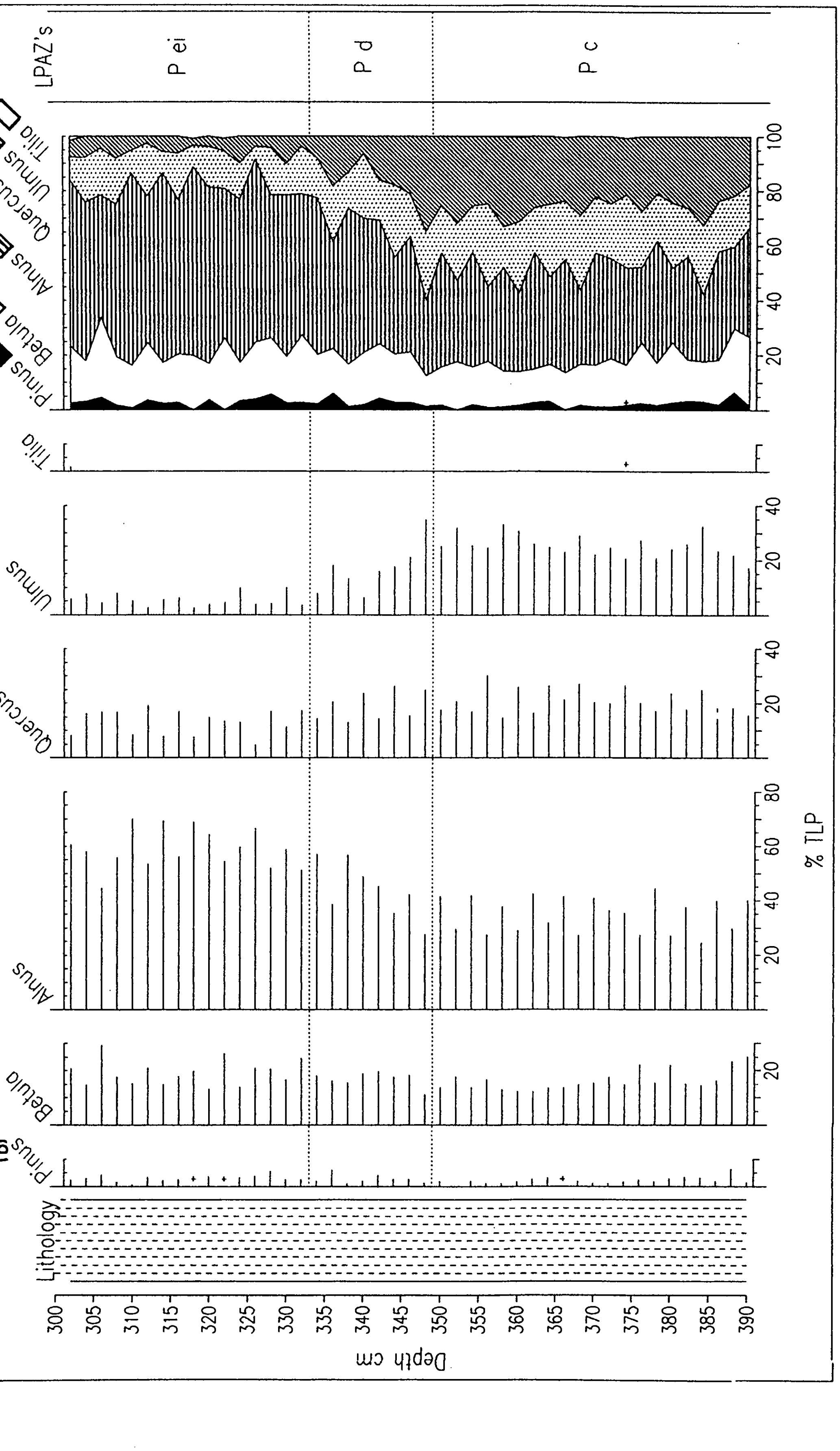
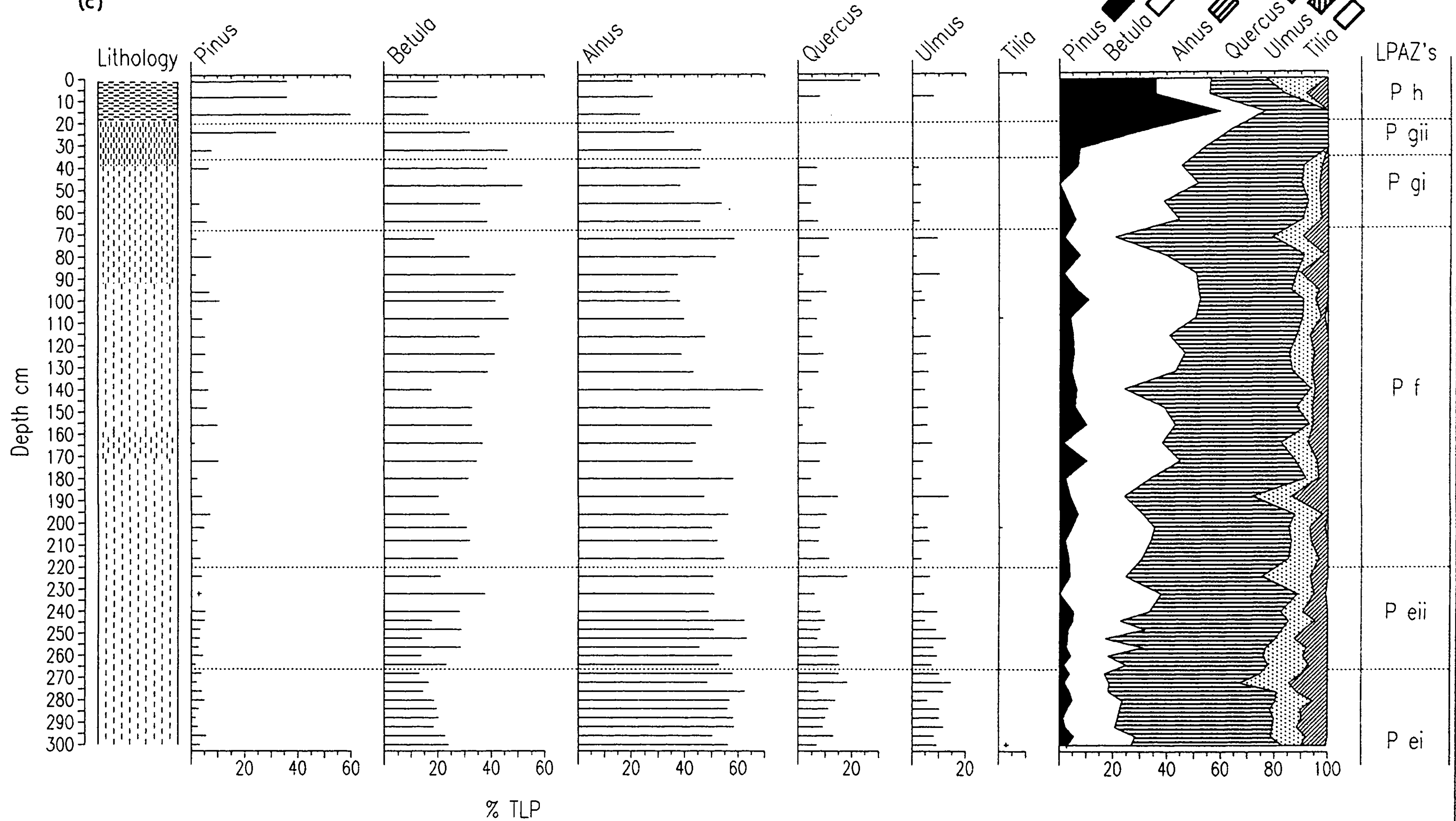


Figure 56 (b) Tree pollen percentage diagram for Pitbladdo.

Figure 56 (c) Tree pollen percentage diagram for Pitbladdo.



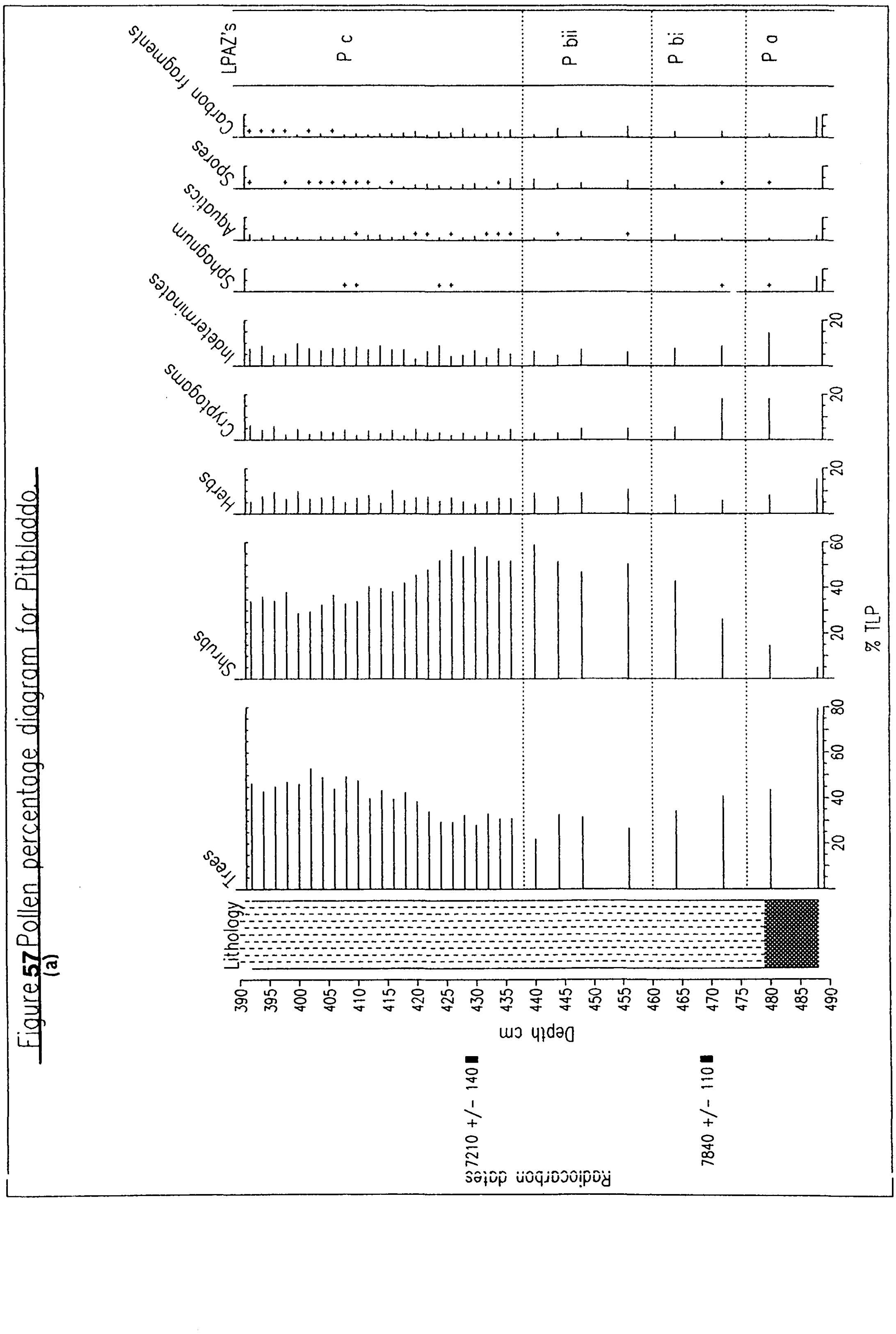


Figure 57 Pollen percentage diagram for Pitbladdo (a)

Figure **57** Pollen percentage diagram for Pitbladdo.
(b)

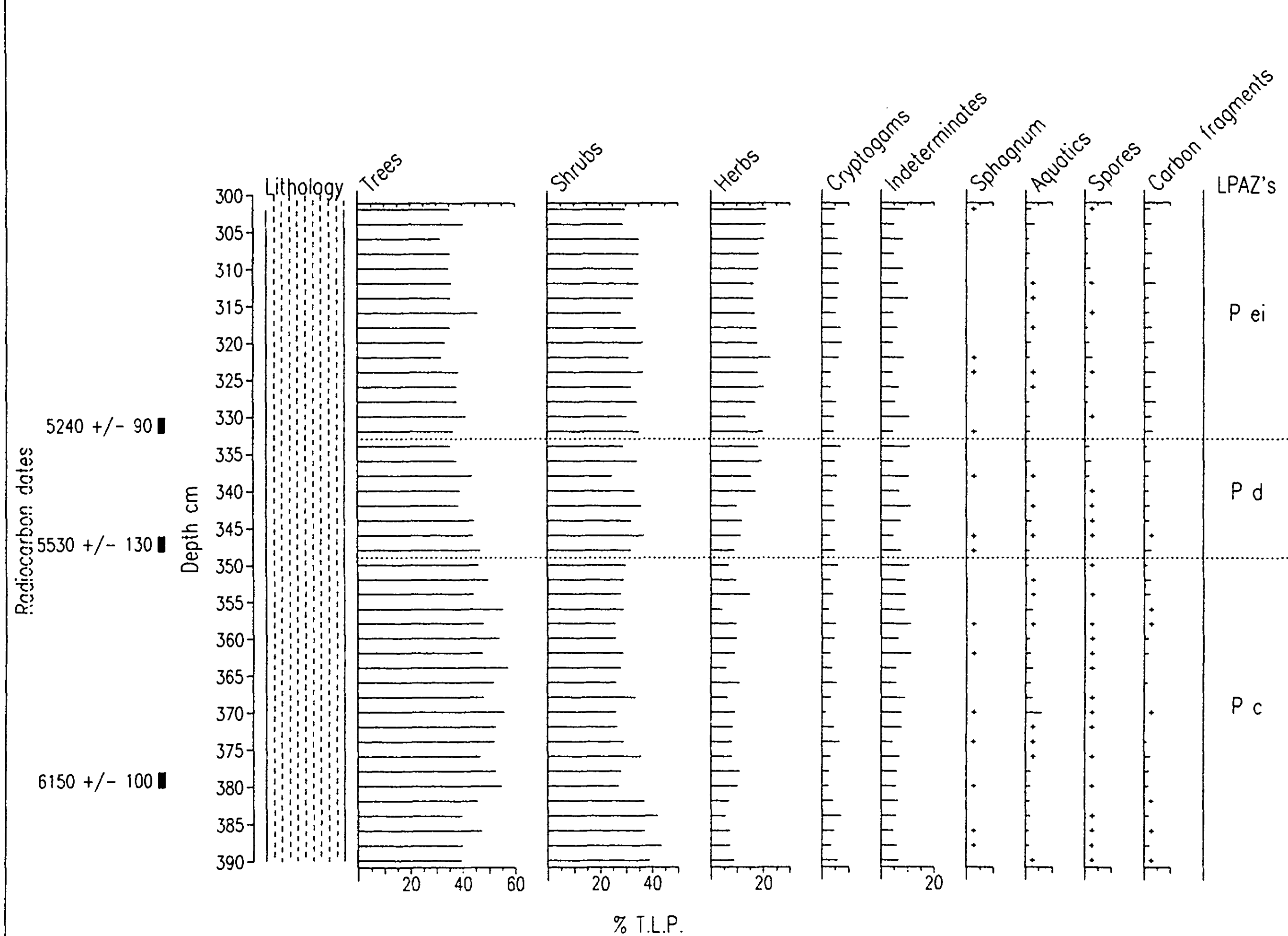
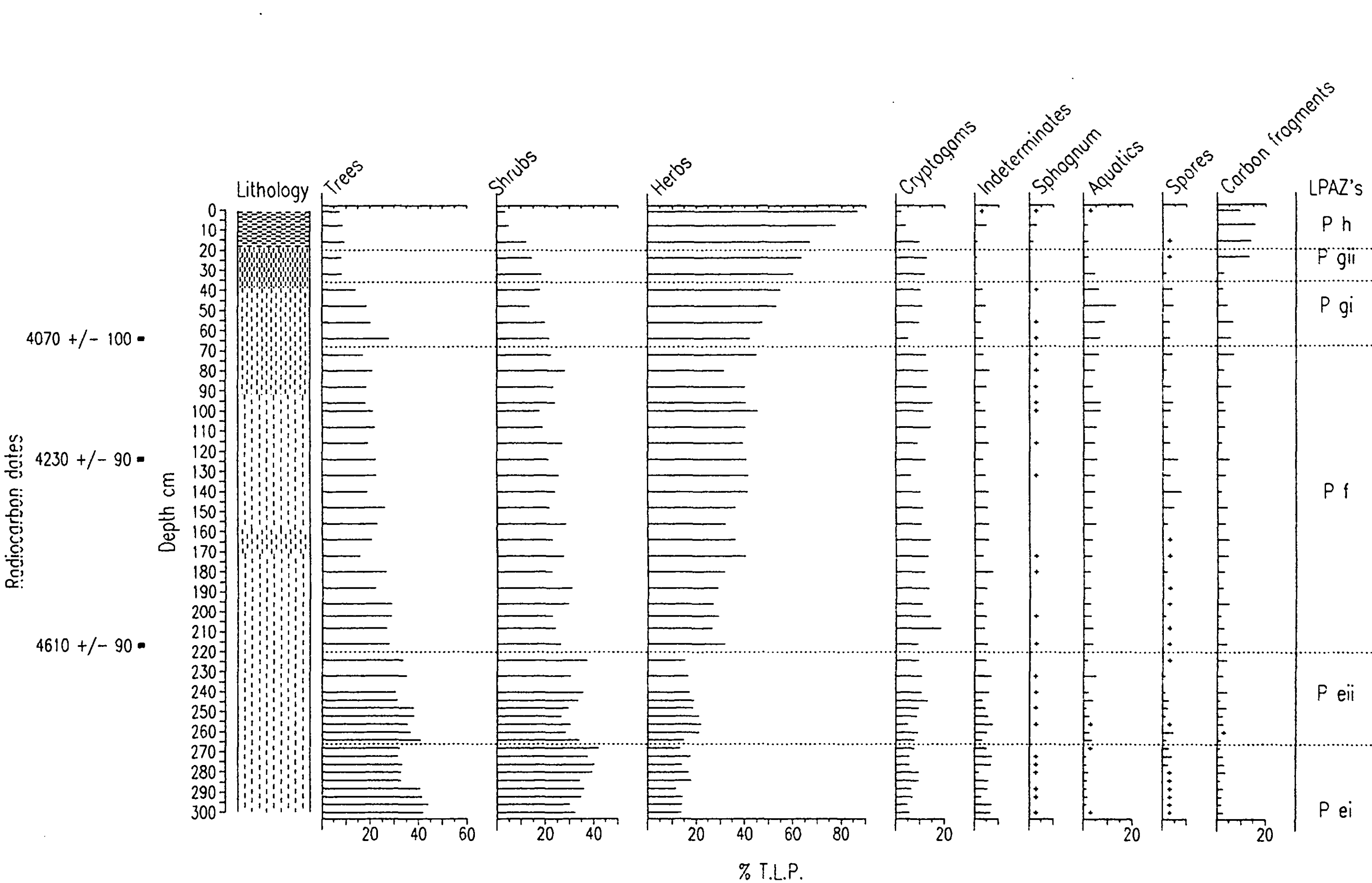


Figure 57 Pollen percentage diagram for Pitbladdo.
(c)



sediment type and pollen assemblage at 479 cm invalidates the assumption of a constant sedimentation rate between sediments above and below this boundary, and that zone Pa may therefore contain pollen assemblages relating to an earlier phase of deposition.

Sediments below 479 cm may contain a compressed record for the early post-glacial period, incorporating the change from a cold open landscape supporting Gramineae and a few herbaceous taxa (e.g. *Artemisia, Rumex*) to a wooded environment dominated by *Betula* and *Corylus*. The presence of *Tilia* and *Ulmus* in the largely inorganic sediments below 484 cm suggests that these sediments may in addition contain pollen from earlier interstadial deposits. The high levels of inorganic material during the early post-glacial, reflect open disturbed environmental conditions vulnerable to erosion leading to the secondary deposition of pollen from sediments of earlier date.

It is suggested that an hiatus in sedimentation occurred during the early post-glacial at Pitbladdo and that the resumption of deposition is marked by the base of the organic muds (479 cm) ca. 7970 BP. The hiatus in the early Holocene record, combined with the possible presence of redeposited pollen in sediments at the base of the profile, prevented the recognition and dating of the arrival of either *Betula* or *Corylus* at Pitbladdo. However, both species appear to have been locally well established by ca. 7870 BP.

Quercus and *Ulmus* appear to arrive simultaneously at ca. 7870 BP, a date outside the isochrones proposed by Birks (1989) but within the range recorded at other local sites (see table 19).

Table 19 The arrival of *Quercus* and *Ulmus* in Fife.

Quercus		
Date	Site	Author
ca. 8500 BP	Black Loch	Whittington *et al.* 1990
7880 +/- 60 BP	Pickletillem	Whittington *et al.* 1991
7430 +/- 100 BP	Methvern	Milburn (Chapter 7 this thesis)
7000 - 7500 BP	Predicted isochrone	Birks 1989
ca. 6990 BP	Cruvie	Milburn (Chapter 5 this thesis)
Ulmus		
Date	Site	Author
8500 - 9000 BP	Predicted isochrone	Birks 1989
ca. 8500 BP	Black Loch	Whittington *et al.* 1990
8470 +/- 60 BP	Pickletillem	Whittington *et al.* 1991
ca. 8110 BP	Methvern	Milburn (Chapter 7 this thesis)
ca. 7650 BP	Cruvie	Milburn (Chapter 5 this thesis)

The arrival of *Quercus* and *Ulmus* marks the opening of a period of mixed deciduous woodland, in which *Corylus*, *Betula*, *Quercus* and *Ulmus* form the dominant constituents. An examination of the absolute pollen diagram (figure 55) shows that the percentage decline in *Betula* values recorded between ca. 7870 and 7620 BP (LPAZ Pbi) is an artefact of the interdependence of the percentage curves. *Betula* pollen concentration values remain generally stable throughout this period, indicating that *Betula* was maintaining a strong local presence despite the expansion of *Corylus*, and may indicate that *Corylus* was forming an dense understorey layer beneath the canopy of established *Betula*.

The low levels of Gramineae and other herbaceous pollen taxa are considered to indicate dense woodland cover with a groundlayer dominated by cryptogams including Filicales, *Polypodium* and *Dryopteris*. The presence of a small number of pollen grains from a range of aquatic taxa including *Potamogeton*, *Nymphaea* and *Myriophyllum* suggests that the coring area was located in an area of open water during this period. The limited representation of fragments of microscopic charcoal throughout zone Pbi indicates that the number and/or size of fire events during this period was limited. On the basis of the available data it was not possible to determine whether the microscopic charcoal recorded represented natural or anthropogenically instigated fires, although it is considered that none of the changes recorded in either the sedimentary or palynological records during zone Pbi appears to reflect human activity.

Between ca. 7620 and 7310 BP (LPAZ Pbii) a slight increase in the number of herbaceous pollen taxa recorded occurred, with *Plantago media/major* and *Mercurialis perennis* recorded for the first time. The significance of this isolated occurrence is difficult to determine as there are no discernible changes in either the representation of the main arboreal taxa, microscopic charcoal or sedimentary data at this time. The arrival of these herbs is considered to reflect the creation of a natural opening within the woodland canopy.

During zone Pbii *Corylus* pollen percentages reach a peak of 60 % TLP at ca. 7370 BP (440 cm) and continue to form the dominant pollen taxa during the period from 7840 +/- 110 to 7210 +/- 140 BP (469 to 429 cm). On the basis of the pollen data it is unclear whether *Corylus* is forming part of the woodland understorey, canopy, or represented in both positions.

The start of LPAZ Pc at ca. 7310 BP marks the rational limit of *Alnus* pollen at Pitbladdo. The isolated occurrence of single grains of *Alnus* pollen at 456 cm (ca. 7620 BP) and 464 cm (ca. 7750 BP) is considered to reflect wind transported pollen rather than a local *Alnus* population at a time when *Alnus* appears to be absent from the study area. Levels of *Alnus* pollen remain low before a gradual increase, which begins at ca. 7130 BP (426 cm). This date is slightly earlier than the one predicted by Birks (1989) but within the range recorded at other local sites (see table 20).

Table 20 The expansion of *Alnus* within the study area.		
Date	Site	Author
ca. 7300 BP	Black Loch	Whittington *et al.* 1990
6500 - 7000 BP	Predicted isochrone	Birks 1989
ca. 6420 BP	Pickletillem	Whittington *et al.* 1991
ca. 6220 +/- 70 BP	Cruvie	Milburn (Chapter 5 this thesis)
ca. 6000 BP	Methvern	Milburn (Chapter 7 this thesis)

It is proposed that the gradual increase in *Alnus* reflects the expansion of the local population as alder colonises the area. Factors influencing the expansion of *Alnus* are discussed in Chapter Eight.

The period between ca. 7310 and 5530 +/- 130 BP (LPAZ Pc) appears to have been dominated by a mixed woodland of *Betula*, *Alnus*, *Quercus*, *Ulmus* and *Corylus* (Figure 56). The continued presence of Gramineae pollen at less than 10 % TLP is considered to indicate a closed woodland environment with few open areas.

Small-scale fluctuations are recorded in all of the main pollen curves including Gramineae and there was also a marked increase in both the number and percentage representation of herbaceous taxa recorded throughout LPAZ Pc. Microscopic charcoal levels remained generally low but also show a number of fluctuations, suggesting the occurrence of small, local fire events throughout this period. The intermittent presence of *Hedera helix* and *Tilia* during zone Pc may reflect an amelioration in the climate, creating conditions favourable to the outbreak of natural fires. However, on the basis of the available evidence it is not possible to determine the origin of the small fire events recorded.

It is suggested that the presence of ruderal taxa tolerant of disturbed conditions (primarily *Rumex*, *Filipendula* and *Ranunculus* type), combined with the changes recorded in individual tree pollen curves and the variations in microscopic charcoal may be attributed to breaks in the woodland canopy, due to windthrow, death or as a result of lightning instigated fires. Alternatively these variations may be indicative of small-scale human activity within a generally closed woodland environment. The small peak in Gramineae pollen values at ca. 6150 +/- 100 BP and the contemporaneous occurrence of *Plantago media / major*, *Plantago lanceolata* and *Caltha* type, may mark an increase in human activity, or the formation of a natural gap in the canopy close to the coring site. The opening of an area close to the coring site would have reduced pollen filtration by a woodland screen and allowed pollen from plants located in the groundlayer to be deposited in the vicinity of the coring site.

The absence of any large-scale increases in Gramineae values between ca. 7310 to 5530 +/- 130 BP (zone Pc) suggests that any clearances undertaken during this period were small-scale in nature, or sufficiently spatially removed from the coring site that they are not recorded within the palynological record. The absence of any changes in the sedimentary record during this period supports the proposal that any human activity occurring was not reflected in the palaeoenvironmental record at this site.

The presence of Cyperaceae, *Sphagnum* and a range of cryptogam and aquatic taxa leads to the suggestion that the coring site was located in a bog containing pools of standing water. It is suggested that changes in representation of these taxa may be considered to reflect changes in the nutrient budget and hydrology of the site. During LPAZ Pc, *Nymphaea* remains the dominant aquatic taxon with *Sphagnum*, *Potamogeton* and *Myriophyllum* recorded sporadically, and it is suggested that these changes may reflect small fluctuations in local water-depth and microhabitat at the coring site over time.

6:6:2 - The mid to late Holocene (ca. 5530 - 3910 BP).

At Pitbladdo two distinct *Ulmus* declines occur during zone Pd (5530 +/- 130 BP to 5240 +/- 90 BP). The first phase of the *Ulmus* decline at Pitbladdo began at 5530 +/- 130 BP culminating at ca. 5420 BP and was followed by a short period of recovery before a second decisive decline at ca. 5240 +/- 90 BP. These dates are somewhat earlier than those recorded at other local sites (table 21) but within the range recorded elsewhere in the British Isles (Hibbert and Switsur 1976, Edwards 1978, Hirons and Edwards 1986).

Table 21 The *Ulmus* decline within the study area

Date	Site	Author
5180 +/- 80 BP	Black Loch	Whittington *et al.* 1990
ca. 5100 BP	Pickletillem	Whittington *et al.* 1991
ca. 4970 BP	Cruvie	Milburn (Chapter 5 this thesis)
ca. 4710 BP	Methvern	Milburn (Chapter 7 this thesis)

Multiple *Ulmus* declines have been noted at a number of sites in Scotland including Black Loch (Whittington *et al.* 1990, Whittington *et al.* 1991). At this site there is no apparent positive correlation between the *Ulmus* declines and microscopic charcoal levels, suggesting that there was no link between fire events and the *Ulmus* declines at this site. Other possible causal factors such as the selective clearance of *Ulmus* by a human population, the use of *Ulmus* leaves for fodder or pathogenic attack appear to be equally feasible. On the basis of the available evidence it is not possible to identify the cause or causes of the *Ulmus* declines recorded at Pitbladdo. The timing and nature of the *Ulmus* declines recorded within the study area are discussed in Chapter Eight.

During LPAZ Pd (5530 +/- 130 - ca. 5240 BP) an overall increase is recorded in the representation of Gramineae pollen, a change that corresponds with the consistent presence of *Urtica* pollen and the first appearance of Compositae pollen. The first record of cereal-type pollen (*Hordeum*-type) occurs at ca. 5420 BP, synchronously with the first *Ulmus* decline.

The pollen concentration diagram for LPAZ Pd shows that there are considerable fluctuations in the values of arboreal and shrub taxa during this period (figure 53). The absence of any significant changes in the representation of wetland and aquatic taxa suggests that changes in hydrological conditions are unlikely to have produced these substantial variations in terrestrial species. It is tentatively proposed that these fluctuations may reflect the creation and abandonment of clearings by a human population, for the purpose of agriculture, and that the overall decline in *Quercus* values may reflect its inability to re-establish itself quickly in areas undergoing regeneration. Work by Aaby (1986, 1988) suggests that human interference in a predominantly wooded environment may result in an increase in the influx of arboreal pollen. It is suggested that the peaks in arboreal pollen concentrations during zone Pd may reflect an increase in the pollen productivity of arboreal taxa resulting in increased rates of pollen deposition.

It is suggested that LPAZ d represents a period of increased environmental disturbance and that human activity is the most likely source of this disturbance. It is proposed that during this period humans were involved in the creation of clearings, for the purpose of mixed and/or pastoral agriculture within the confines of a predominantly wooded environment. The absence of any increases in the representation of microscopic charcoal suggests that this activity did not involve the intensive use of fire. The absence of any indications of disturbance in the sedimentary record suggests that any activity did not result in erosion, or was sufficiently distant from the coring site to be 'invisible' in the sedimentary record.

During LPAZ Pei (5240 +/- 90 to ca. 4860 BP) Gramineae pollen values increased to between 8% and 17%, cereal type pollen (*Hordeum* type) and a range of ruderal taxa was recorded including *Rumex*, Caryophyllaceae, Chenopodiaceae, Rosaceae, *Plantago media/major*, *Plantago lanceolata* and Compositae. Together these changes imply an increase in the amount of disturbance in the area surrounding Pitbladdo.

The representation of pollen of arboreal taxa and Gramineae all fluctuates during LPAZ Pei. It is suggested that these changes may reflect a pattern of woodland management, with different areas periodically being the focus of more intense activity, leading to increases in the representation of Gramineae, cereal-type and herbaceous pollen, followed by periods of regeneration allowing a recovery by the faster growing arboreal taxa such as *Alnus* and *Betula*.

The range of aquatic taxa recorded during this period is considered to reflect changes in the nutrient budget and water depth. The sporadic occurrence of *Myriophyllum*. which presently favours water of less than 1 m in depth (Rieley and Page 1990), may reflect periodic decreases in water depth, possibly related to phases of increased sediment input due to increased erosion rates in areas cleared of woodland. Fluctuations in the percentage of mineral material in sediments from this LPAZ (see LOI figure 47) also appear to indicate phases of increased sediment input, resulting in an increase in the percentage of mineral material. The variations in pollen concentrations recorded (figures 44 and 51) may reflect alternating phases of fast (low concentrations) and slow (high concentrations) sediment deposition, which may be related to periods of increased erosive sediment input.

It is considered that the continuous but fluctuating microscopic charcoal curve could represent the aggregated record of numerous fire events, possibly at different locations, throughout this period. As each centimetre slice of sediment analysed represents approximately six years of sediment accumulation the microscopic charcoal record is reflecting trends rather than individual fire events. It is suggested that the peaks recorded may reflect :

i) An increase in small fires in the vicinity of the coring site,

ii) The occurrence of larger fire events, leading to increased charcoal deposition across a wide area,

iii) A combination of the above.

On the basis of the available data, recognition of the cause of charcoal peaks is not possible, and the peaks recorded could reflect both anthropogenic and naturally instigated fire events. Fire may have been used to maintain the open areas recorded during this period. However, no clear correlation exists between peaks in microscopic charcoal and increases in Gramineae pollen, making it difficult to substantiate this link. The possibility of natural fires cannot be dismissed and the presence of both *Tilia* and *Hedera helix* indicate relatively warm dry conditions, which could increase the incidence of natural fires occurring in response to lightning strikes. It is further suggested that changes in the abundance and range of aquatic taxa might reflect changes in water depth related to changes in climatic conditions. For further discussion of possible climate change, see Chapter Eight.

It is suggested that the fluctuations in arboreal taxa, combined with the increased representation of herbaceous taxa including cereal-type pollen during LPAZ Pei reflect agricultural activity within a woodland environment during the early Neolithic period. The variations in the representation of individual pollen taxa are considered to reflect changes in the pattern of landuse over time, whilst the lack of large-scale variations in vegetation composition is considered to suggest woodland management by the local human population. It is further proposed that the changes in aquatic taxa and sedimentary data indicate periodic increases in sediment inwash, which may be linked to increased soil erosion caused by land clearance during episodes of increased agricultural activity.

The patterns of disturbance outlined in LPAZ Pei continue during LPAZ Peii (ca. 4860 to 4610 +/- 90 BP). However, during LPAZ Peii a further increase in the overall representation of Gramineae pollen is recorded, whilst the percentage representation of arboreal pollen falls from 40 % to 30 % TLP. These changes could represent an increase in the area of land undergoing modification. One of the key distinctions between the sub-zones Pei and Peii is the pollen curve of

Betula, which shows fluctuations of up to 6 % between adjacent levels. It is proposed that the variations recorded in the *Betula* pollen curve may be reflecting the periodic partial clearance of an area of birch woodland formerly left relatively undisturbed, although it is recognised that it is not possible to assess the validity of this proposal on the basis of the available data.

The start of LPAZ Pf at 4610 +/- 90 BP sees a marked increase in the values of Gramineae pollen from 8 % TLP at the end of LPAZ Peii to 22 % TLP at the start of LPAZ Pf. It is suggested that the abrupt increase in Gramineae pollen recorded at the start of this zone could represent either an increase in the total amount of land undergoing clearance, or alternatively increased land clearance in the immediate vicinity of the coring site, leading to a reduction in arboreal pollen from local sources. Following this initial increase Gramineae pollen values fluctuate between 19 % and 30 % TLP, whilst the overall representation of arboreal pollen falls from 24 % to 20 % TLP (figure 57). The fluctuating mineral content of sediment analysed from this LPAZ (217 cm to 65 cm), combined with an increase in the percentage of mechanically damaged pollen grains recorded, indicate, that increased sediment inwash was occurring during this period. On the basis of this evidence it is considered likely that the increased presentation of Gramineae during this LPAZ is reflecting increased clearance activity close to the site.

It is considered that increases in the representation of Cyperaceae pollen percentages could reflect the expansion of sedges at the marsh edge, as episodes of increased sediment input resulted in increased silting. The continued presence of aquatic taxa suggests that agricultural exploitation of the site itself was probably not possible, although it may have provided a useful local water resource.

The absence of any substantial peaks in microscopic charcoal during this period (figure 54) suggests that fire was not being extensively used as a land management tool, but the incidence of charcoal throughout could reflect small fires relating to other types of human activity, such as camp fires or crop processing. Alternatively small natural fires could have produced similar background levels of microscopic charcoal.

The slight increase in the number of herbaceous taxa recorded and the sporadic appearance of cereal-type pollen combined with the high representation of Gramineae during Pf, indicate that the practice of mixed and/or pastoral agriculture, first recorded in LPAZ Pei and Peii is continued throughout LPAZ Pf, and spans the early Neolithic period from 5240 +/- 90 to 4070+/- 90 BP

The start of LPAZ Pgi at 4070 +/- 100 BP marks the last recovery in arboreal taxa recorded at this site (figure 57), with peaks recorded in both *Betula* and *Alnus* pollen. Following this brief recovery, which may reflect the expansion of these faster growing species, possibly during a phase when the area closest to the site was not being actively utilised, levels of arboreal pollen steadily fall, reaching 8 % TLP at the end of the LPAZ (figure 57). *Corylus* pollen values also show an overall decline from 19 % to 7 % TLP. The relative stability of Gramineae pollen values combined with the presence of cereal-type pollen (*Hordeum* type) suggest that agricultural activity is continuing throughout this period, whilst the amount of remaining woodland is gradually reduced.

A peak in mineral matter recorded between 52 cm and 56 cm suggests a period of sediment inwash, which might be linked in the cultivation of land immediately adjacent to the site. However, this event appears to have had little impact on overall pollen production and is not discernible in the pollen record. The range and abundance of aquatic taxa recorded in this LPAZ (figures 54) indicate that the site is maintaining areas of open water, whilst the increased representation of Cyperaceae pollen suggests the establishment of a sedge-dominated marsh fringe, possibly reflecting the start of hydroseral succession.

LPAZ Pgii (ca. 3990 to 3950 BP) marks the disappearance of *Quercus* and *Ulmus* from the pollen record, suggesting that they have been cleared from this area of northern Fife. Overall the representation of arboreal and Gramineae pollen remain stable, whilst the high organic content of sediments in this zone suggests that little sediment movement is being experienced.

It is suggested that LPAZ Pgii represents a period of stability in relation to anthropogenically instigated change. However, the continued increase in Cyperaceae pollen levels and the decline in the abundance of aquatic pollen taxa, culminating in the disappearance of six of the seven taxa at the end of the zone, suggests that gradual infilling and hydroseral succession may have been occurring throughout this period. This apparent change in environmental conditions is reflected in the statigraphic record where a change from a silty mud to a silt is recorded at 39 cm, just below the base of LPAZ Pgii.

The start of LPAZ Ph is marked by an increase in *Pinus* pollen values from 2 % to 6 % TLP. It is suggested that this increase may represent the incorporation of pollen from a distant source area, the absence of substantial woodland in the vicinity of the site resulting in a sharp increase in the representation of wind-transported *Pinus* pollen. However, the absence of any large increases in *Pinus* during the previous three LPAZs when woodland cover was declining, combined with the abruptness of the increase, to 60 % of arboreal pollen (figure 56), suggest the presence of a local source area. It is suggested that this increase may be related to the planting of pine woodland in this area, a practice that was first instigated during the 18th century.

It is proposed that the upper part of the palaeoecological record at Pitbladdo may contain an hiatus and it is suggested that the low arboreal and high herbaceous values recorded in LPAZ Ph (16 cm to 0 cm) may represent the vegetation history of this area during the historic period. It is suggested that the high mineral content of samples from this LPAZ, combined with the high percentage of mechanically damaged grains recorded, may reflect further inwashing of sediments from the surrounding land. Alternatively these changes could reflect the post-depositional compaction of pollen due to the use of modern heavy machinery on the site during silage collection and the addition of mineral material in fertilisers added to improve production. The high levels of microscopic charcoal recorded in this LPAZ may be related to the practice of stubble burning in the area surrounding the site, a practice that only ceased in the early 1980s.

The termination of the pollen record at approximately 3900 BP indicates that a considerable depth of material is missing from this site. It is considered unlikely that the site dried to such an extent that all deposition ceased, as the site occupies the lowest point within a closed basin and until the 1980's when underground drainage pipes and a pumping system were laid across the site, supported a marshland community. A more likely explanation would be the removal of peat from the site by humans. The presence of Lordscairnie Castle (dating from the medieval period) at the edge of the catchment area lends support to the idea that deposits were removed for use as fuel, or as organic soil conditioner for the sandy soils in the area.

Chapter Seven - The palaeoenvironmental record at Methvern.

7:1 - Introduction.

Methvern is the largest of the three site investigated and provided the most complete palaeoenvironmental record, covering the period from approximately 10 500 BP to the present day (section 7:2). Sedimentary data are presented in figures 58 to 64 and tables 22 and 23. Pollen data are presented in figures 65 to 70 located in the folder at the back of this volume. Summary diagrams (figures 71 and 72) are located at the end of section 7:5. The raw data used in the production of these figures and tables are presented in Volume Two, Appendix Two.

7:2 - Radiocarbon dates.

Five radiocarbon assays were obtained on material from Methvern (table 22). These dates form the chronological framework for the site and are used in the calculation of the time-depth curve (figure 58) and pollen influx rates (figure 59). All dates are expressed as uncalibrated radiocarbon years BP.

Table 22 details of the radiocarbon assays for Methvern.

Laboratory number	Mean depth (cm)	Sediment thickness (cm)	Fraction	^{14}C age BP	1 σ	$\delta^{13}C$ ‰	Calibrated age range AD/BC 1σ
GU4091	128	127-129	Humin & Humic	1830	60	-28	AD 112-245
GU4092	208	207-209	Humin & Humic	3590	90	-27	2123-1787 BC
GU4090	320	319-321	Humin & Humic	4710	90	-28	3630-3367 BC
GU4089	401	400-402	Humin & Humic	5890	70	-28	4896-4721 BC
GU4088	480	479-481	Humin & Humic	7430	100	-28	6420-6130 BC

7:3 - Sediment stratigraphy.

The sediment stratigraphy recorded at Methvern is shown in table 23 and figure 60. The site is underlain by inorganic cross-bedded sandstones (see Chapter One). Overlying the sandstone deposits are 17 cm of pale grey silty clays (636 to 653 cm). A sharp boundary between the clays and an amorphous brown peat is recorded at 636 cm (ca. 10 450 BP). The amorphous peat extends for 246 cm (390 to 636 cm) and shows only one clear colour change at 620 cm (ca. 10 140 BP). At 390 cm (ca. 5720 BP) there is a change to a *Sphagnum*-rich peat, which extends to the top of the core. Close examination of the *Sphagnum* peat reveals several zones of compacted *Sphagnum*, possibly reflecting periods of slower peat growth, and these bands are indicated in table 23. The

Figure 58 Time-depth curve for sediments from Methvern.

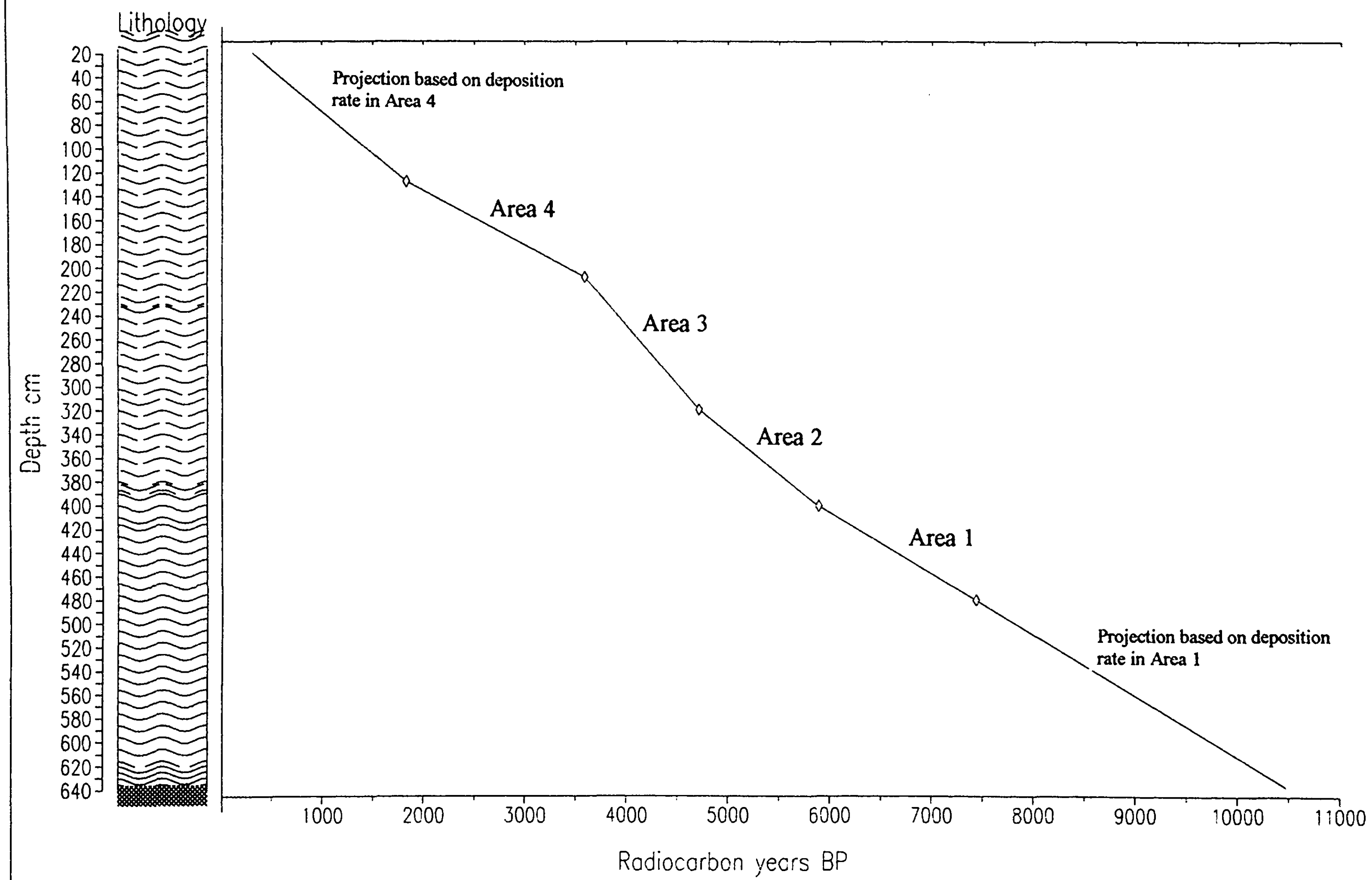


Figure 59 Concentration, grains cm $^{-3}$ wet sediment x 10^3 and Influx, grains/cm/year for Methvern

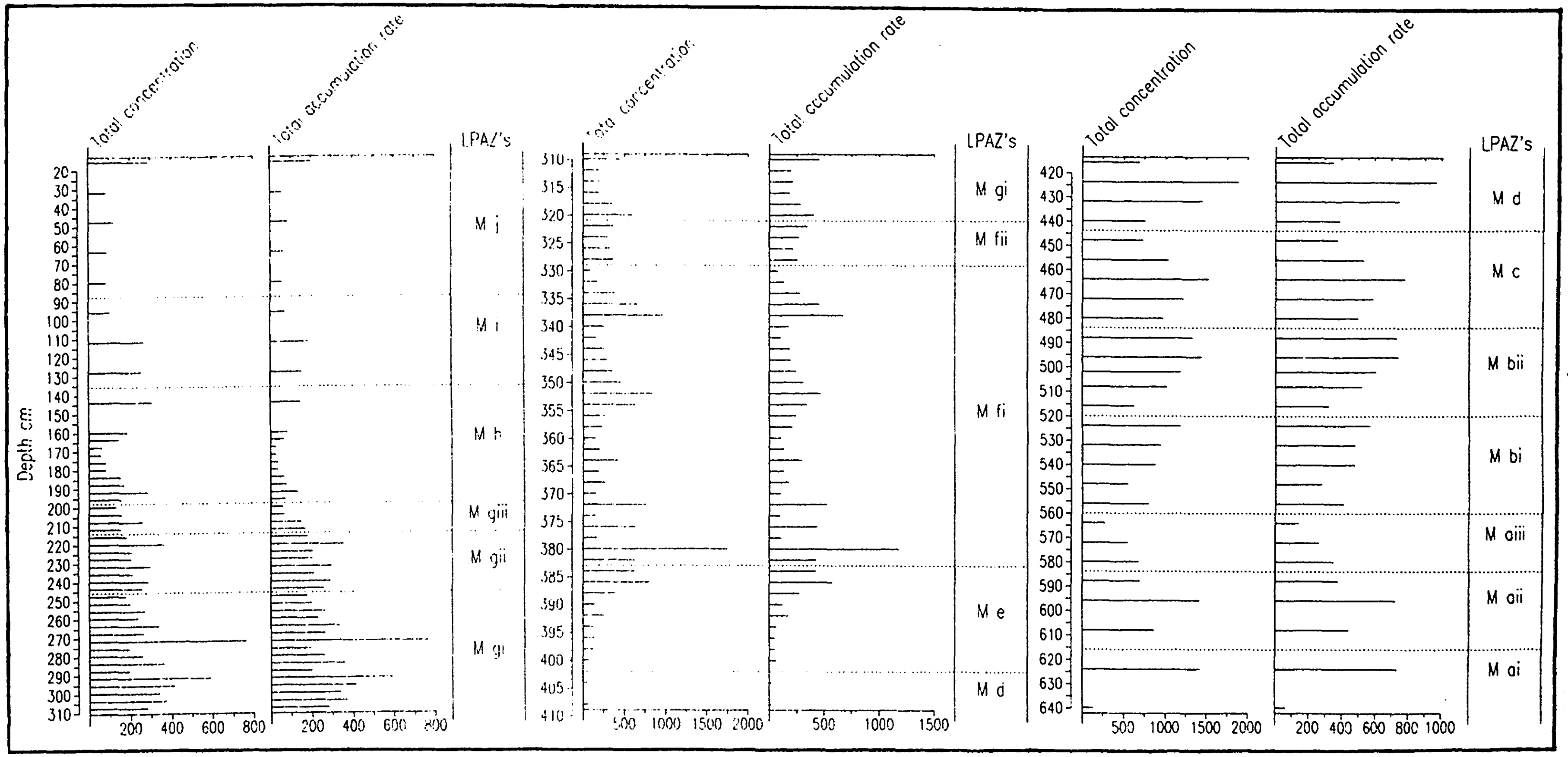
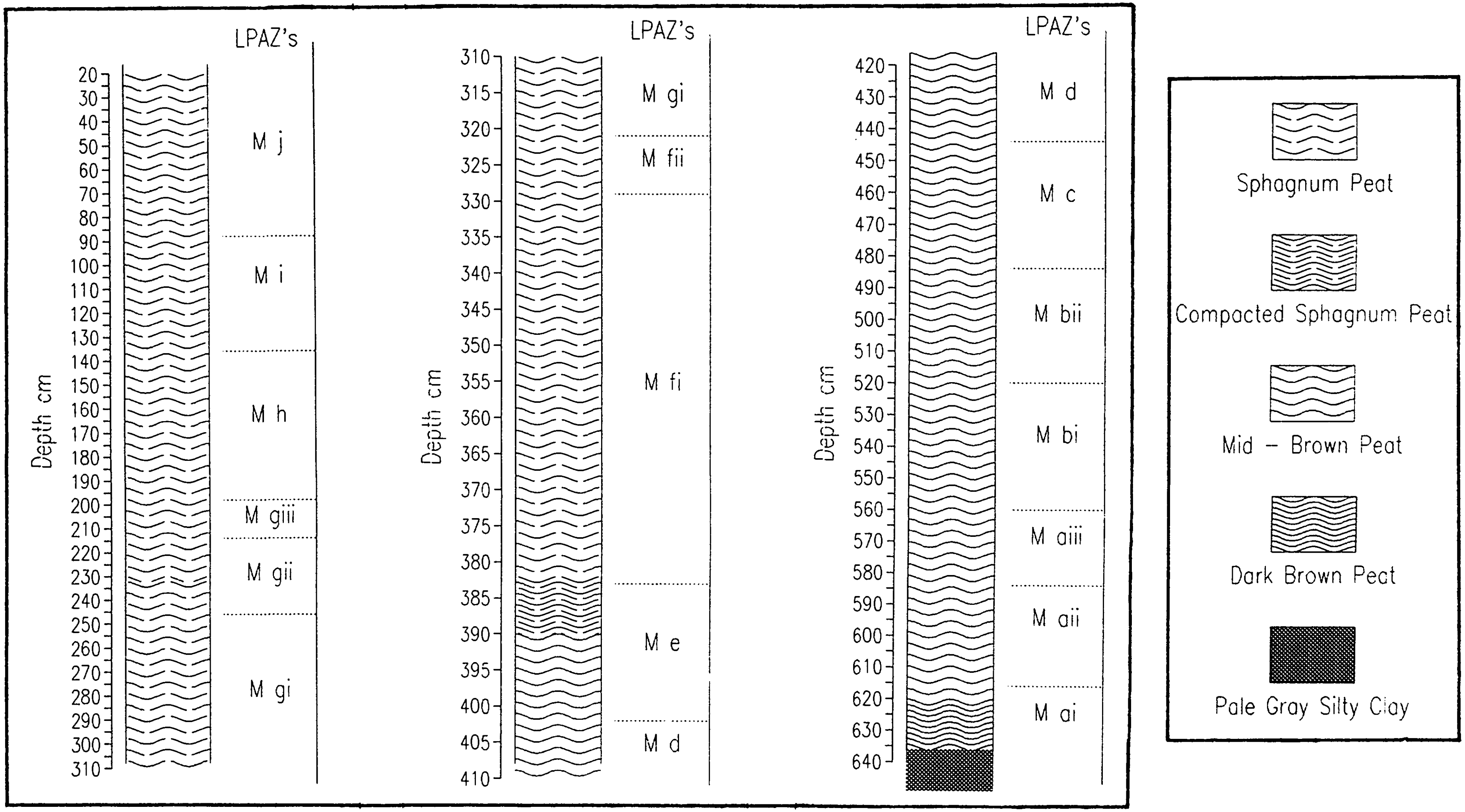


Figure 60 Lithology for Methvern



upper 4 cm of the *Sphagnum* rich peat contains modern roots extending from the present ground surface.

Table 23 details the sediment stratigraphy recorded at Methvern.

Depth in cm	Sediment type
0 - 4	Compacted *Sphagnum* rich peat, containing modern roots, gradual transition to
4 - 230	*Sphagnum* rich peat, gradual transition to
230 - 232	Compacted *Sphagnum* rich peat, sharp transition to
232 - 382	*Sphagnum* rich peat, gradual transition to
382 - 390	Compacted *Sphagnum* rich peat, gradual transition to
390 - 620	Mid-brown amorphous peat, gradual transition to
620 - 636	Dark brown amorphous peat, sharp transition to
636 - 653	Pale grey silty clay.

7:4 - Sedimentary record.

This section outlines the main features of the sedimentary record at this site. The sedimentary data obtained from Methvern include pH, loss-on-ignition, magnetic susceptibility, pollen preservation, pollen concentration and sediment deposition rates and are summarised in Figures 58 to 64. The primary data used in the production of these figures are presented in Volume Two Appendix Two.

The pH values recorded at Methvern (figure 61) range from 3.6 to 4.6, indicating the presence of acidic conditions suited to the preservation of pollen. The minor fluctuations recorded do not show any clear correlation with changes in stratigraphy (table 23) or other sedimentary data.

Loss-on-ignition readings from Methvern (figure 62) indicate that the basal clays, dating from ca. 10 530 BP, contain only a small amount of organic material (6 %), indicating the presence of limited amounts of vegetation locally in the period immediately following deglaciation. An increase in organic matter (to 39 %) at 636 cm marks the transition at ca. 10 450 BP from the mainly inorganic basal clays to the overlying organic peats. Between 632 cm and 478 cm (ca. 10370 to 7390 BP) the percentage of organic material reaches greater than 90 % and in the period from ca. 7390 BP to the present day, levels generally remained at greater than 96 % organic matter. These values are considered to reflect the absence of inwashed material and the limited aerial input of mineral material into a raised bog site. Increases in mineral content appear as troughs in figure 62.

A series of large peaks in mineral matter was recorded at both Cruvie and Pitbladdo, but only one such episode is recorded at Methvern. At 50 cm (ca. 730 BP) mineral matter increases to 13 % and then slowly returns to previous low levels over the subsequent 20 cm. This episode is different in character to those recorded at the other sites, where the percentage of mineral matter generally increased gradually and then showed an abrupt decline. It was suggested that this pattern

Figure 61 pH diagram for Methvern.

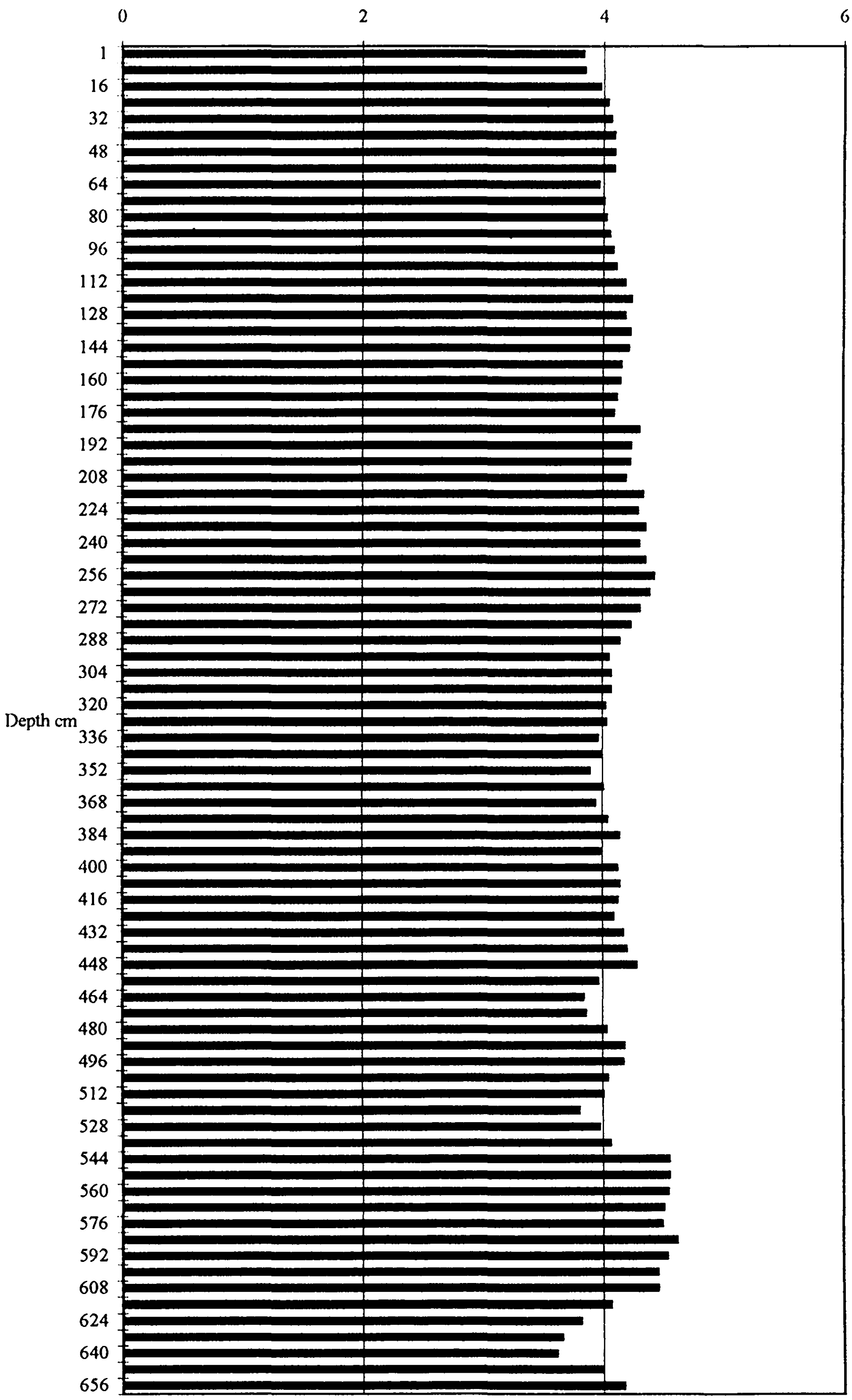
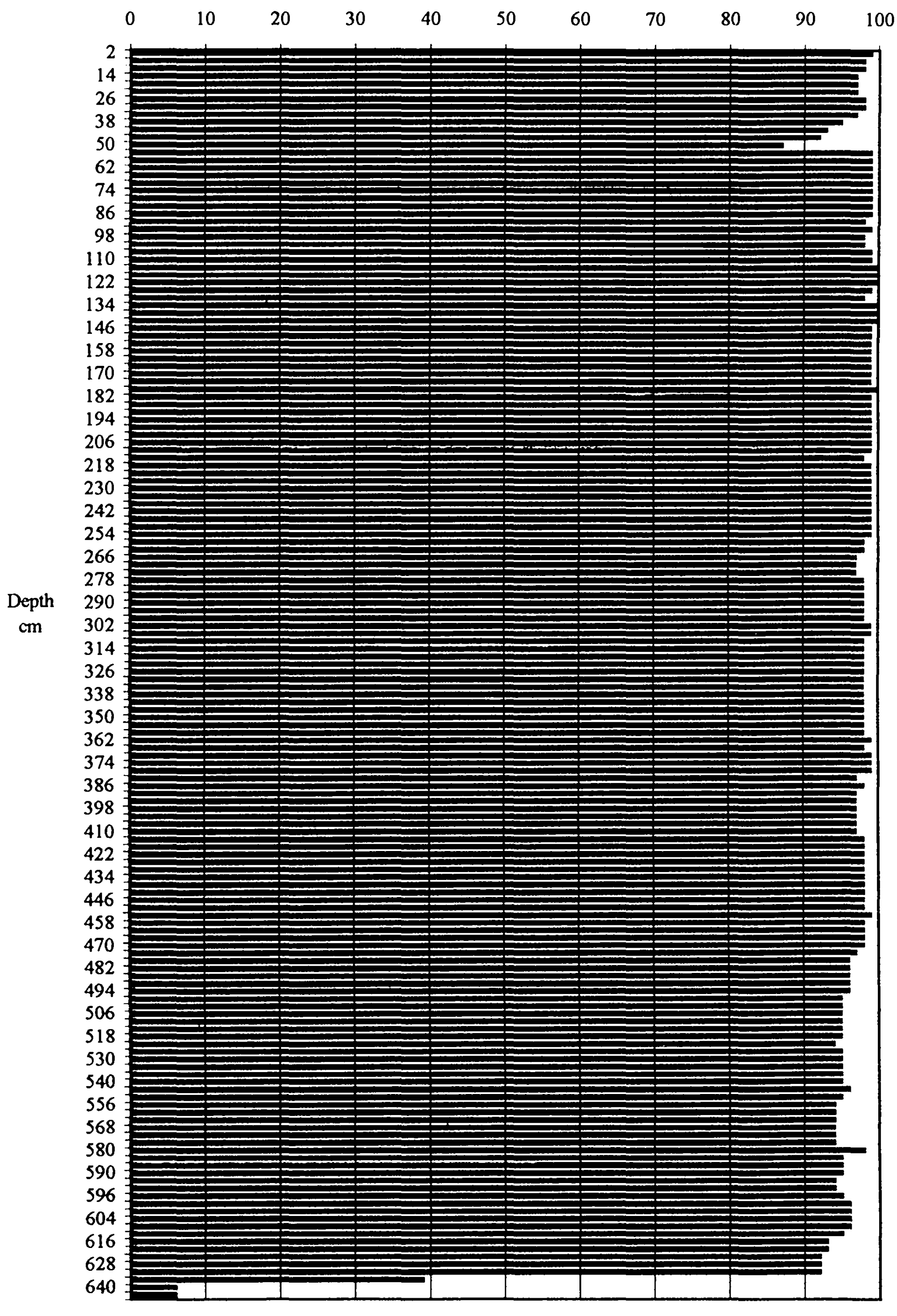


Figure 62 Loss on ignition for Methvern.



reflected a period of increasing disturbance and sediment movement followed by stabilisation, and possibly related to land clearance followed by plant regrowth (either natural or cultivated). The sharp increase at Methvern is considered to reflect an abrupt event followed by a period of slow stabilisation. It is suggested that this peak may reflect the deposition of wind-blown material from an area of open land close to the site, although on the basis of the available data this proposal remains speculative. The possibility that experimental error may have resulted in a false reading at this level was considered. Replication of this analysis using a new sample resulted in an identical reading, suggesting the initial analysis was accurate.

Magnetic susceptibility readings (figure 63) from the basal clays (636 cm to 653 cm) and the initial 15 cm of the overlying peat recorded positive readings of 0.1 to 0.3 and 0.7 to 4.6 respectively, indicating the presence of magnetic minerals in the inorganic basal sediments. The extremely high organic content of the peats at Methvern is considered to reflect limited sediment input at this site. It is suggested that the small peaks in magnetic susceptibility recorded from the peat deposits probably reflects wind transportation of mineral material from exposed areas of soil or bedrock in the surrounding area. The peak in mineral matter recorded by LOI at 50 cm (ca. 730 BP) was not identified by magnetic susceptibility, suggesting that material deposited during this event did not contain ferromagnetic minerals.

Pollen recovered from the basal sediments at Methvern (figure 64) include a high percentage (51 %) of mechanically damaged grains, with a smaller percentage (25 %) of chemically damaged grains. It is suggested that this damage reflects transportation and exposure to oxidising conditions before deposition. Pollen preservation throughout the rest of the core (figure 64) is variable with normal (well-preserved) pollen accounting for between 25 % and 92 % of the pollen sum.

In the period between ca. 10 220 BP (624 cm) and ca. 5930 BP (404 cm) damaged pollen accounts for between 32 % and 50 % of the pollen sum. It is suggested that the corroded grains recorded reflect damage due to oxidisation or microbial activity, whilst the crumpled grains recorded may reflect compaction of grains within sediments following deposition. Physical damage due to stress during transportation is considered unlikely owing to the lack of supporting evidence (e.g. from LOI, magnetic susceptibility) for substantial sediment transportation.

In the period between ca. 5890 BP (400 cm) and ca. 5720 BP (390 cm) there is an overall increase in the percentage of normal pollen recorded. Following this transitional period, levels of normal pollen increase to form above 70 % of the pollen sum for the majority of the rest of the core. This change corresponds to an increase in the deposition rate at this site and it suggested that this increase could have reduced the time that pollen grains were exposed to oxidising conditions, and consequently produced a fall in chemical damage. It is further proposed that the decrease in the percentage of crumpled grains recorded could reflect a reduction in compaction within younger sediments. Alternatively an examination of the sediment stratigraphy recorded at this site (table 22 ,

Figure 63 Magnetic susceptibility for Methvern.

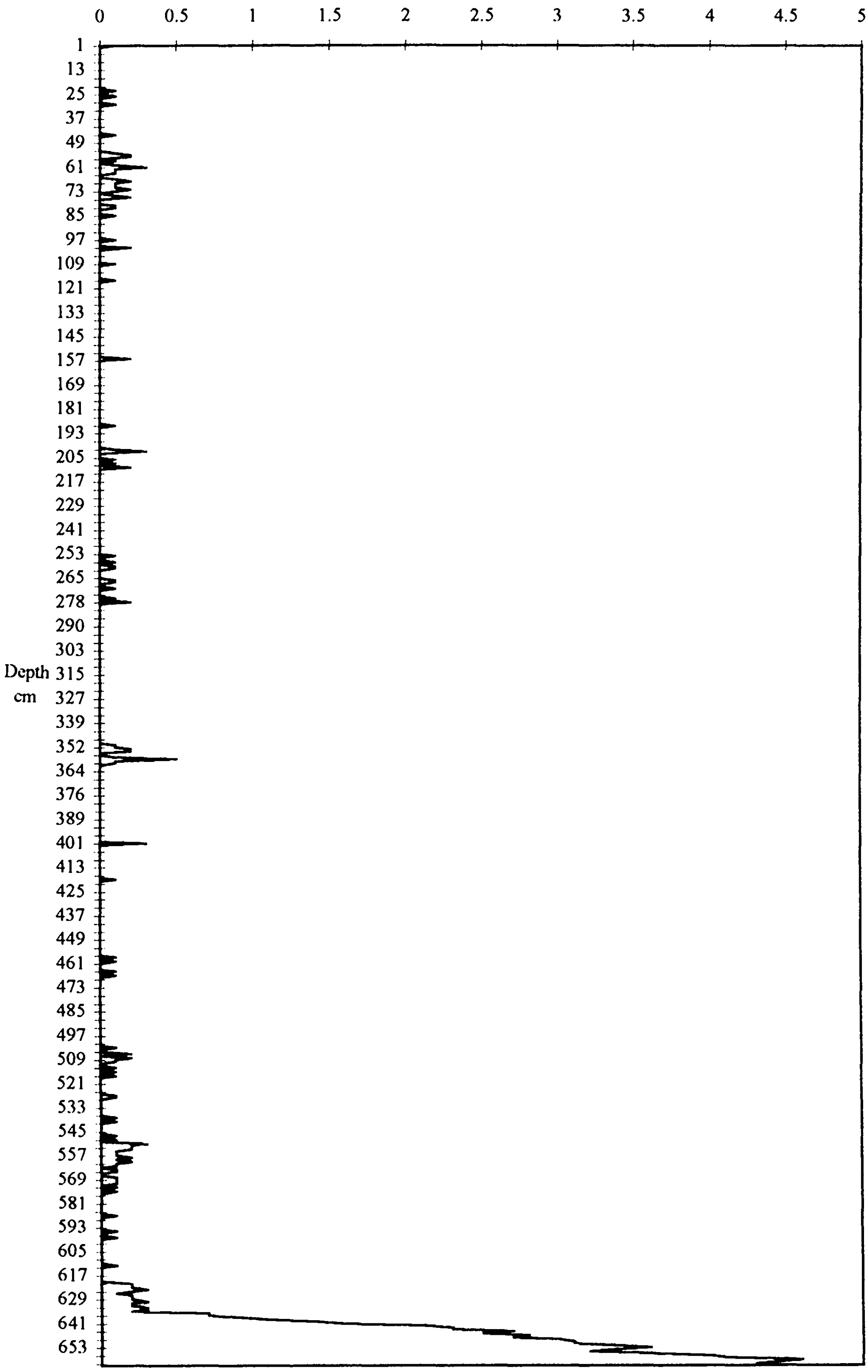


Figure 64 (a) Pollen preservation diagram for Methvern.

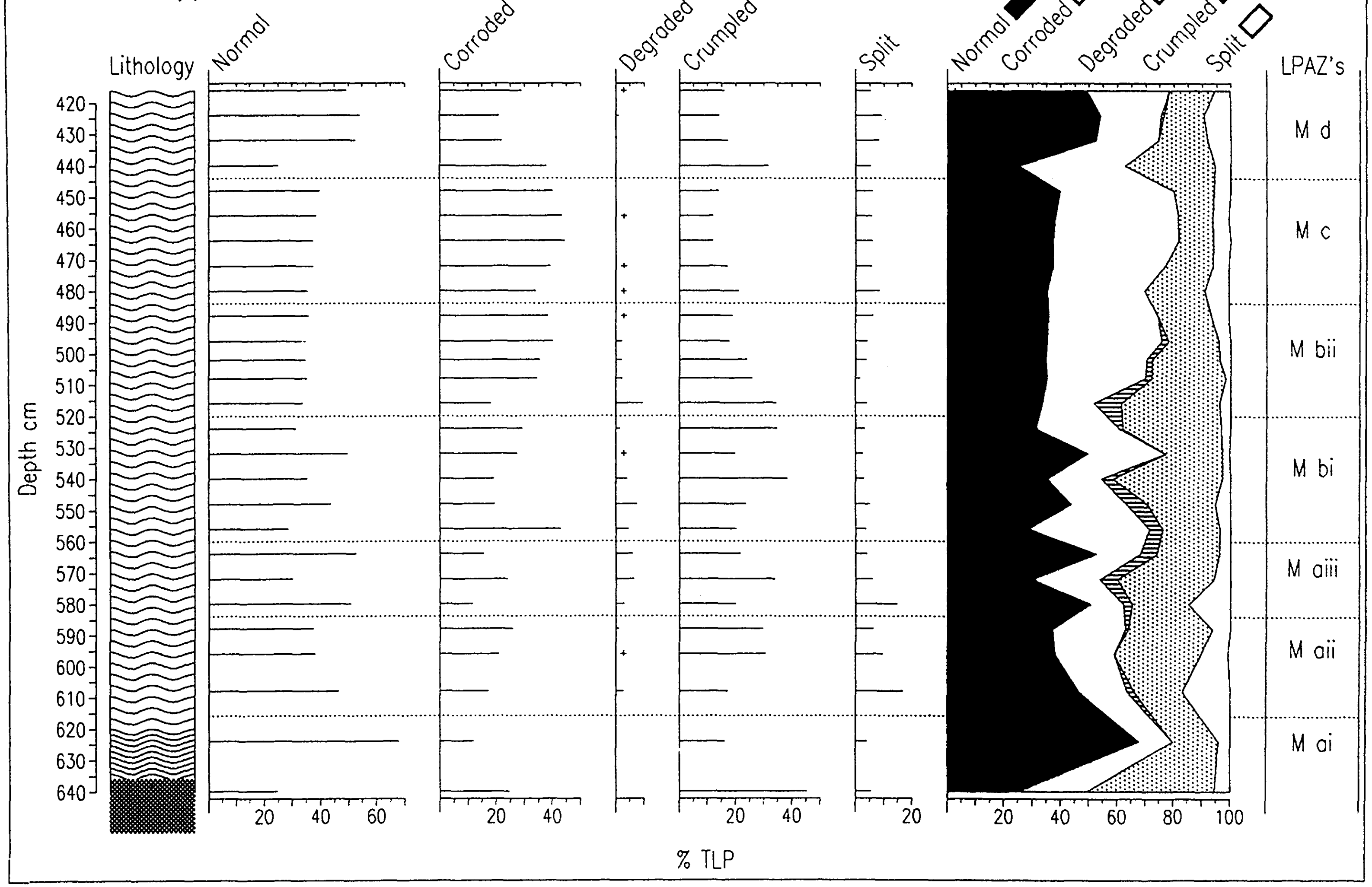


Figure **64** Pollen preservation diagram for Methvern.
(b)

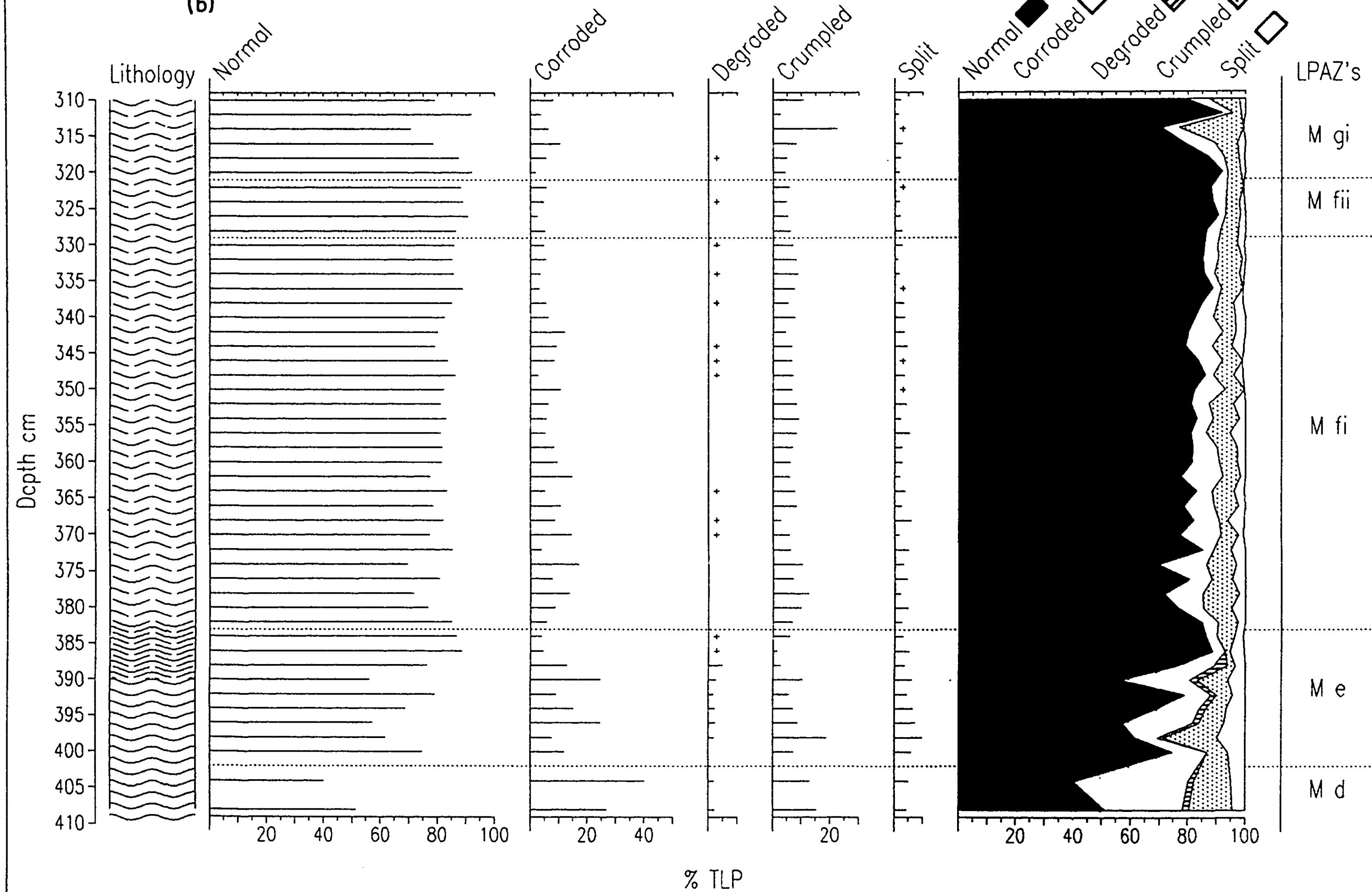


Figure 64 Pollen preservation diagram for Methvern (c)

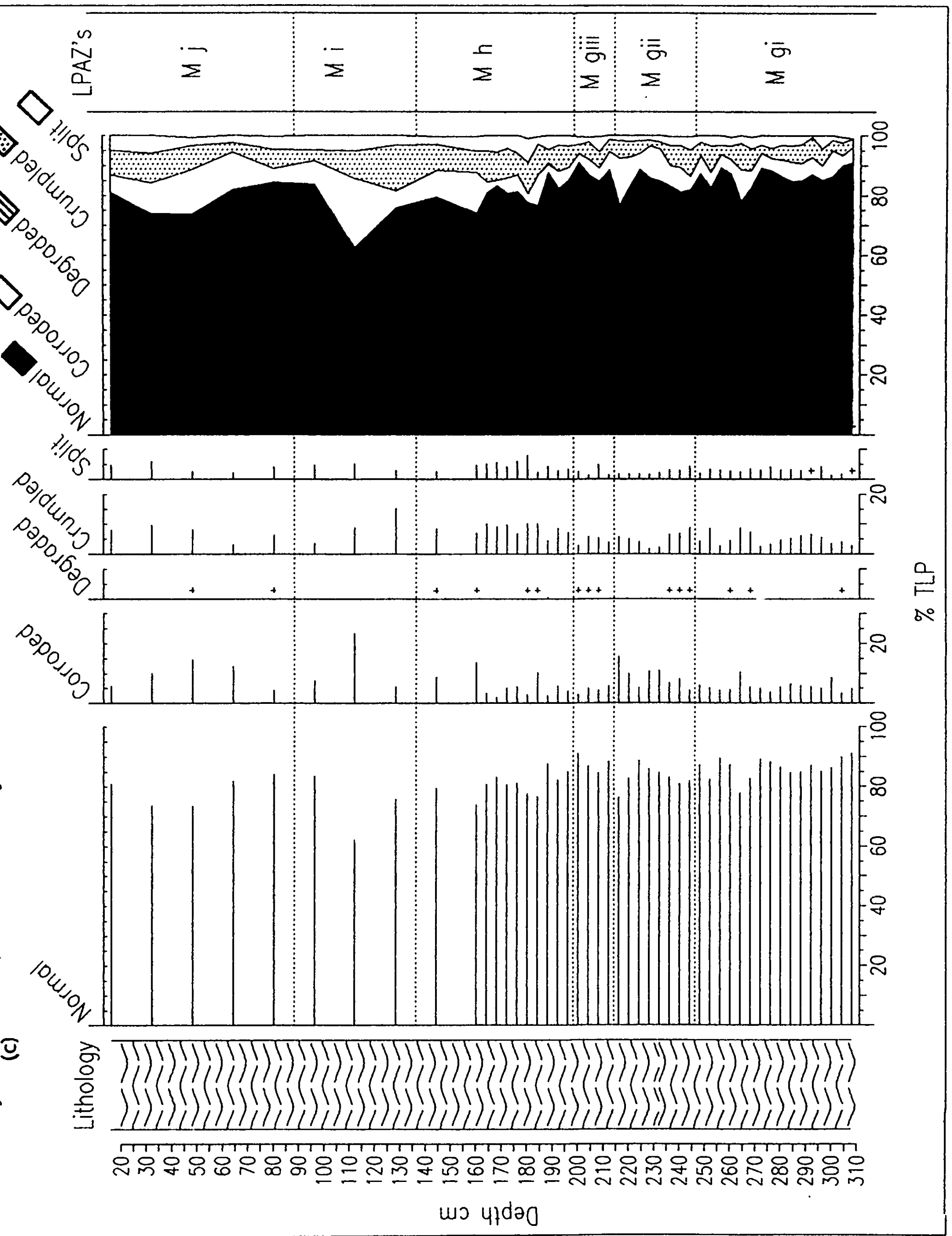


figure 60) shows that the change from an amorphous peat to a *Sphagnum*-rich peat occurs at 390 cm. It is suggested that this transition may represent a significant change in the depositional environment at this site and that the changes in pollen preservation are reflecting this alteration.

The minor peaks in damaged grains that occur throughout the upper part of the core, for example increased crumpling at 316 cm (ca. 4660 BP) and peaks in corrosion at 264 cm (ca. 4140 BP), 216 cm (ca. 3660 BP) and 112 cm (1616 BP), are considered to reflect minor variations in environmental conditions. However, as these alterations are not reflected by changes within any of the other sedimentary parameters examined, causal factors for each of these events remains unclear.

Sediment deposition rates at Methvern show little variation (figure 58). The lack of radiocarbon assays from the base of the site prevents the calculation of early Holocene (before 7430 BP) deposition rates, and dates assigned to this period are based upon rates recorded in area 1. A deposition rate of 0.05 cm yr^{-1} is recorded between 7430 +/- 100 and 5890 +/- 70 years BP (area 1), increasing slightly in areas 2 (0.07 cm yr^{-1}) and 3 (0.10 cm yr^{-1}), before a return to 0.05 cm yr^{-1} in area 4.

The average deposition rate of 0.06 cm yr^{-1} at this site is slightly slower than those recorded at Cruvie (0.09 cm yr^{-1}) and Pitbladdo (0.15 cm yr^{-1}); and the resultant degree of temporal resolution slightly lower, averaging 16.5 yr cm^{-1} in comparison to 11.6 yr cm^{-1} at Cruvie and 12.4 yr cm^{-1} at Pitbladdo.

Pollen concentrations and influx rates (figure 59) calculated on the basis of sediment deposition rates show considerable fluctuations but consistently mirror each other throughout the core. The lowest concentrations (12×10^3 grains cm^{-3}) were recorded from the basal silty clays (640 cm) and are considered to reflect low pollen productivity by a limited number of species, in the period immediately following deglaciation. The fluctuations in pollen concentrations recorded throughout the rest of the core (from a low of 28×10^3 grains cm^{-3} at 564 cm to 17×10^4 grains cm^{-3} at 380 cm) are considered to reflect changes in the composition of the surrounding vegetation, or fluctuations in the pollen productivity of individual taxa in response to changing environmental conditions.

7:5 - Local Pollen Assemblage Zones (LPAZs).

The pollen diagrams from Methvern are divided into 16 LPAZs based on the major taxa in the percentage pollen diagrams. The diagrams span the period from 10 500 years BP to the present day and the dates referred to in the text are extrapolations and interpolations from the time-depth curve (figure 58). General pollen diagrams (figures 65 to 70) are located in the folder at the back of this volume. Summary pollen diagrams (figures 71 and 72) are located at the end of section 7:5.

LPAZ	LPAZ depth in cm	Age range uncalibrated years BP.
M j	81 - 0	1160 - 20
M I	129 - 81	1830 - 1160
M h	197 - 129	3300 - 1830
M giii	213 - 197	3620 - 3300
M gii	245 - 213	3940 - 3620
M gi	321 - 245	4710 - 3940
M fii	329 - 321	4810 - 4710
M fi	383 - 329	5600 - 4810
M e	401 - 383	5890 - 5600
M d	441 - 401	6630 - 5890
M c	481 - 441	7430 - 6630
M bii	517 - 481	8110 - 7430
M bi	557 - 517	8890 - 8110
M aiii	581 - 557	9380 - 8890
M aii	609 - 581	9910 - 9380
M ai	640 - 609	10530 - 9910

LPAZ M ai : 640 to 609 cm - ca. 10530 to 9910 BP.

This LPAZ marks the transition from the late Devensian to the early Holocene. The basal sediments at Methvern contain low levels of arboreal and shrub pollen and high levels of Gramineae and other herbaceous pollen. A gradual increase in arboreal pollen frequency from 8 % to 29 % TLP reflects the expansion in *Betula* pollen. *Betula* replaces *Pinus* as the dominant arboreal pollen taxon, expanding from 30 % to 93 % of the total arboreal pollen. Other features include the peak in Empetraceae pollen at 624 cm (ca. 10 220 BP) and the presence of the aquatic *Menyanthes trifoliata* and the algal spore *Pediastrum*.

LPAZ M aii : 609 581 cm - ca. 9910 to 9380 BP.

Betula pollen reaches its maximum of 28 % TLP at the start of this zone. The representation of *Betula* pollen subsequently falls slightly before stabilising at 20 % TLP for the remainder of the zone. The pollen percentages of both Gramineae and Cyperaceae increase reaching 47 % and 18 % TLP respectively. This zone marks the first isolated occurrence of *Sphagnum* spores at less than 1 % total land pollen plus spores (TLPS).

<u>LPAZ M aiii</u> : 581 to 557 cm - ca. 9380 to 8890 BP.

This zone is characterised by the expansion of *Corylus* pollen percentages from 4 % TLP at the base to its maximum of 60 % TLP at the upper end of the zone. The levels of the other main pollen taxa all fluctuate considerably during this zone. Peaks in both Gramineae and Cyperaceae correspond to a fall in the representation of *Betula* pollen. However, overall there is a decline in the percentage values of both Gramineae, from a maximum of 37 % TLP and Cyperaceae, from a maximum of 20 % TLP.

<u>LPAZ M bi</u> : 557 to 517 cm - ca. 8890 to 8110 BP.

This zone is characterised by high levels of *Corylus* pollen, representing greater than 40 % TLP. Generally the levels of arboreal pollen fluctuate only slightly, forming between 10 and 15 % TLP. During this zone the first intermittent appearances of *Alnus*, *Quercus* and *Ulmus* pollen at less than 1 % TLP are recorded. Cryptogams are strongly represented during this zone reaching 10 % TLP at 532 cm (figure 65).

<u>LPAZ M bii</u> : 517 to 481 cm - ca. 8110 to 7430 BP.

This zone is characterised by a gradual decline in *Corylus* pollen percentages from 45 % to 17 % TLP. Between 516 cm and 496 cm (ca. 8110 to 7720 BP) arboreal pollen increases its representation from 15 % to 27 % TLP, followed by a slight decline to 22 % TLP by the end of the zone (figure 72). *Betula* remains the dominant arboreal pollen taxa throughout this zone. The start of this zone marks the first occurrence of *Ulmus* pollen at levels greater than 1 % TLP. Gramineae pollen increases sharply from 15 % to 30 % TLP at the start of the zone and then remains relatively stable throughout the zone.

<u>LPAZ M c</u> : 481 to 441 cm - ca. 7430 to 6630 BP.

The start of this zone corresponds to a increase in Gramineae pollen to 35 % TLP. Both *Quercus* and *Ulmus* pollen are recorded throughout this zone at between 2 % and 3% TLP. The representation of arboreal pollen remains generally stable at approximately 22 % TLP during the first half of this zone before rising to 30 % TLP at 448 cm (ca. 6790 BP). This increase reflects the increase in *Pinus* pollen from 5 to 12 % TLP. Overall both *Corylus* and Gramineae pollen values fall during this zone.

<u>LPAZ M d</u> : 441 to 401 cm - ca. 6630 to 5890 BP.

At the start of this zone *Corylus* reaches a low of 5 % TLP and there is an increase in the representation of Cyperaceae to 25 % TLP. The zone is characterised by low levels of arboreal pollen, which form 15 % to 20 % TLP. The pollen values of individual arboreal taxa all fluctuate during this zone. *Corylus* pollen values increase throughout Md, rising from 5 % to 29 % TLP

Levels of Cyperaceae fall steadily from a peak of 25 % to 3 % TLP. Gramineae values start and end the zone at 30 % TLP, dipping in the middle to between 10 % and 13 % TLP.

<u>LPAZ M e</u> : 401 to 383 cm - ca. 5890 to 5600 BP.

The start of this zone marks the start of the expansion of *Alnus* pollen, with values of 10 % to 19 % TLP being recorded. High levels of *Betula* pollen are also recorded during this zone. Although *Betula* values fluctuate considerably, readings of 35 % TLP are reached at several levels. *Quercus* and *Ulmus* pollen values increase in this zone. Overall, the representation of arboreal pollen increases rapidly from 35 % to 70 % TLP. Levels of Gramineae and Cyperaceae pollen fluctuate considerably but overall remain low. The number of herbaceous taxa recorded increases during this zone.

<u>LPAZ M fi</u> : 383 to 329 cm - ca. 5600 to 4810 BP.

This zone is characterised by gradual changes in the representation of arboreal pollen; values fluctuate between 35 % to 50 % TLP. Levels of *Quercus* and *Ulmus* pollen remain low but record slight increases. Levels of Ericaceae pollen increase markedly reaching peaks of 25 % TLP at 376 cm (ca. 5510 BP) and 340 cm (ca. 4990 BP). The peak recorded at 340 cm corresponds to the first occurrence of cereal-type pollen (*Hordeum* type) at Methvern. The values of *Quercus*, *Ulmus* and *Corylus* pollen all fall slightly at this level. Gramineae pollen values remain consistently low throughout the zone and *Rumex* pollen is recorded at values greater than 1 % TLP from 338 cm (ca. 4960 BP).

<u>LPAZ M fii</u> : 329 to 321 cm - ca. 4810 to 4710 BP.

This zone spans the period of the first prolonged (i.e., greater than two level) *Ulmus* decline at Methvern. Values of *Ulmus* pollen drop from 9 % to less than 1 % TLP. No changes are recorded in the representation of pollen from other arboreal taxa. Levels of *Corylus* and Ericaceae pollen also show little variation.

<u>LPAZ M gi</u> : 321 to 245 cm - ca. 4710 to 3940 BP.

This zone is characterised by gradual changes in arboreal pollen values with levels fluctuating between 26 % and 44 % TLP (figure 67). *Ulmus* pollen percentages recover slightly from the low levels recorded in LPAZ Mfii, maintaining values of 1 to 2 % TLP. Gramineae and Cyperaceae pollen levels remain low, whilst an overall increase is recorded in the number of herbaceous pollen taxa. *Urtica* pollen and *Pteridium* spores are recorded continuously at less than 1 % TLP and TLPS respectively.

LPAZ M gii : 245 to 213 cm - ca. 3940 to 3620 BP.

During this zone a marked increase is recorded in the representation of *Betula* pollen between 232 cm and 226 cm (ca. 3820 to 3780 BP), reaching a peak of 20 % TLP. This increase corresponds to a fall in the levels of Ericaceae from 15 % to 7 % TLP. Gramineae pollen values fluctuate considerably but overall remain low at less than 10 % TLP.

LPAZ M giii : 213 to 197 cm - ca. 3620 to 3300 BP.

This zone is characterised by an increase in the representation of *Alnus* pollen; on average values are 5 % higher than in LPAZ Mgii. Percentages of *Ulmus* pollen fall to less than 1 % TLP and a slight fall is recorded in *Corylus* pollen. The number of herbaceous pollen taxa present increases and a single grain of cereal-type pollen (*Hordeum* type) is recorded.

LPAZ M h : 197 to 129 cm - ca. 3300 to 1830 BP.

The start of this zone marks a period of increased Gramineae pollen values, rising from 4 % TLP in LPAZ Mgiii to a maximum of 18 % TLP in LPAZ Mh. Values of arboreal pollen fluctuate but fall slightly during this zone. *Corylus* pollen values increase during the first half of this zone but then decline slightly in the second half of the zone. The diversity and percentage representation of herbaceous pollen also falls during the second half of the zone.

LPAZ M i : 129 to 81 cm - ca. 1830 to 1160 BP.

This zone is characterised by a recovery in the values of arboreal pollen from 20 % to 38 % TLP, a trend attributable to increases in the representation of *Betula* and *Alnus* pollen. *Corylus* values decline during this zone. After a period of initial stability Gramineae pollen values also decline. A single grain of cereal-type pollen (*Hordeum* type) is recorded at the start of the zone. Ericaceae values show a marked increase at the start of the zone, rising from 4 to 10 % TLP in Mh to 20 to 30 % TLP throughout M i.

LPAZ M j : 81 to 0 cm - ca. 1160 to 20 BP.

During this zone there is a gradual increase in the representation of Gramineae pollen and a maximum of 20 % TLP is reached. Cereal-type pollen grains (*Hordeum* type) are recorded at three levels. Generally arboreal pollen values decline throughout this zone. However peaks in *Betula* at 48 cm (ca. 700 BP) and *Alnus* at 36 cm (ca. 530 BP) produce a two-level reversal in this trend. *Quercus* and *Ulmus* pollen are recorded intermittently.

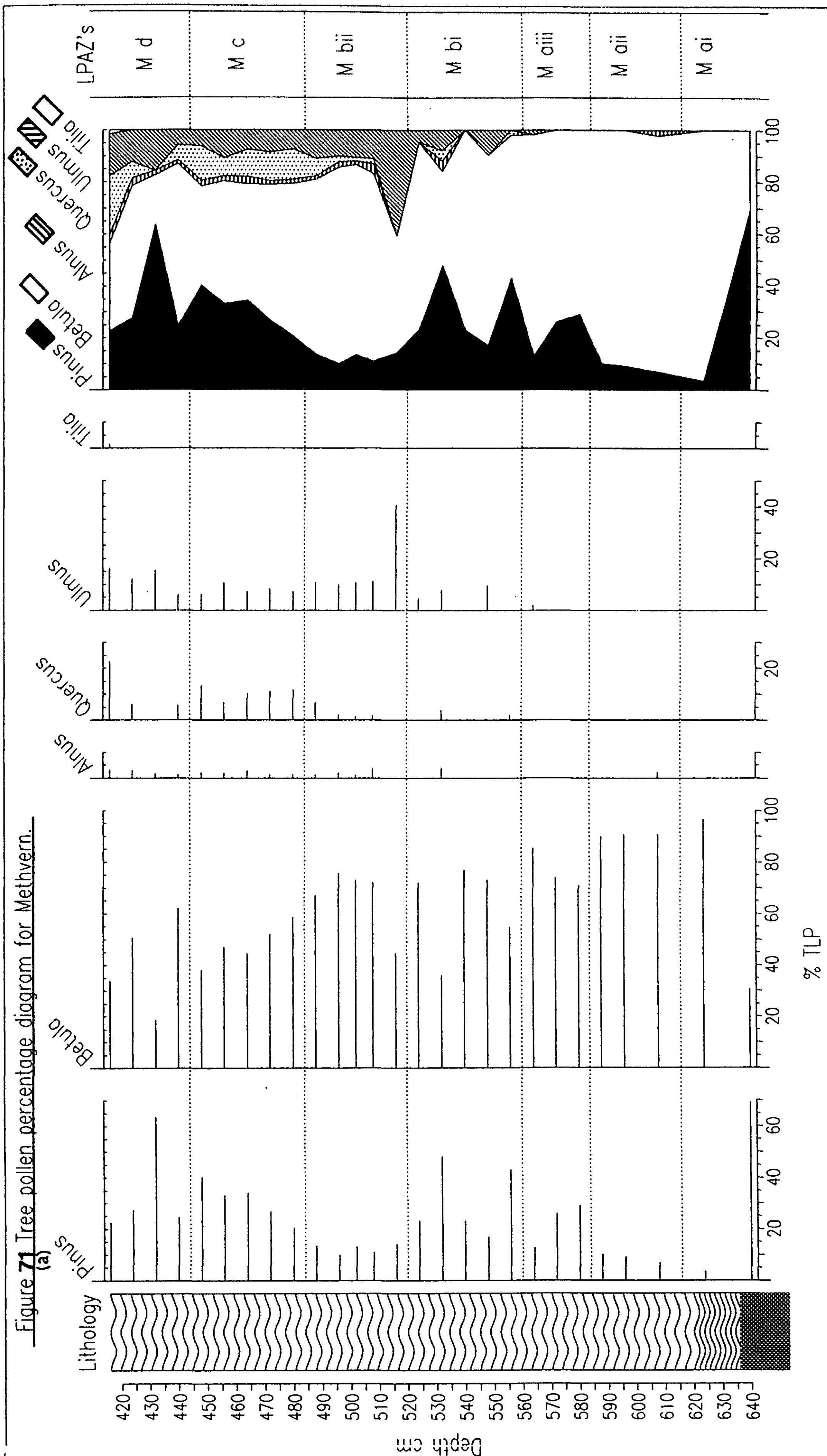
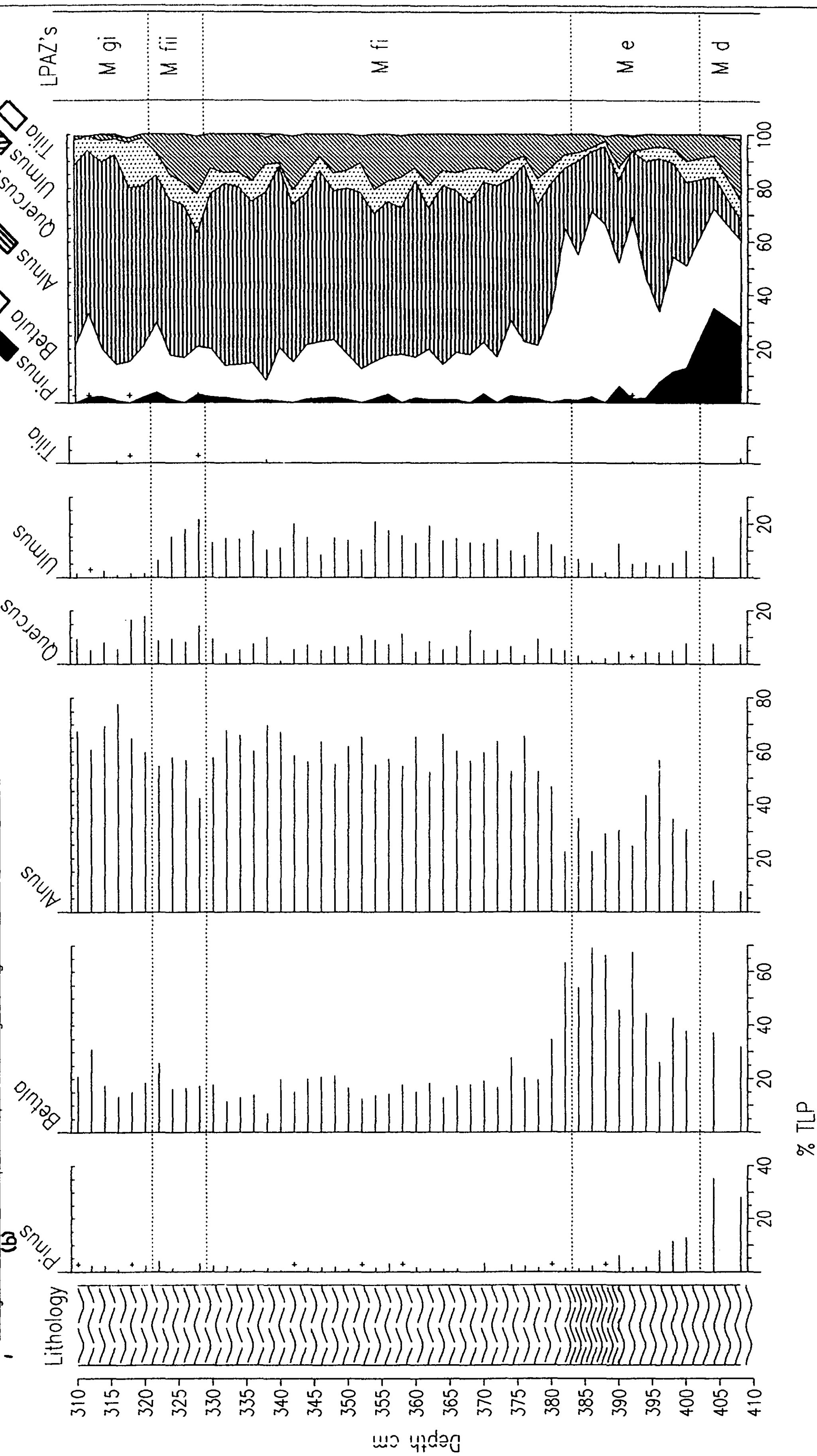


Figure 71 Tree pollen percentage diagram for Methvern.
(a)

Figure 71 (b) Tree pollen percentage diagram for Methvern.



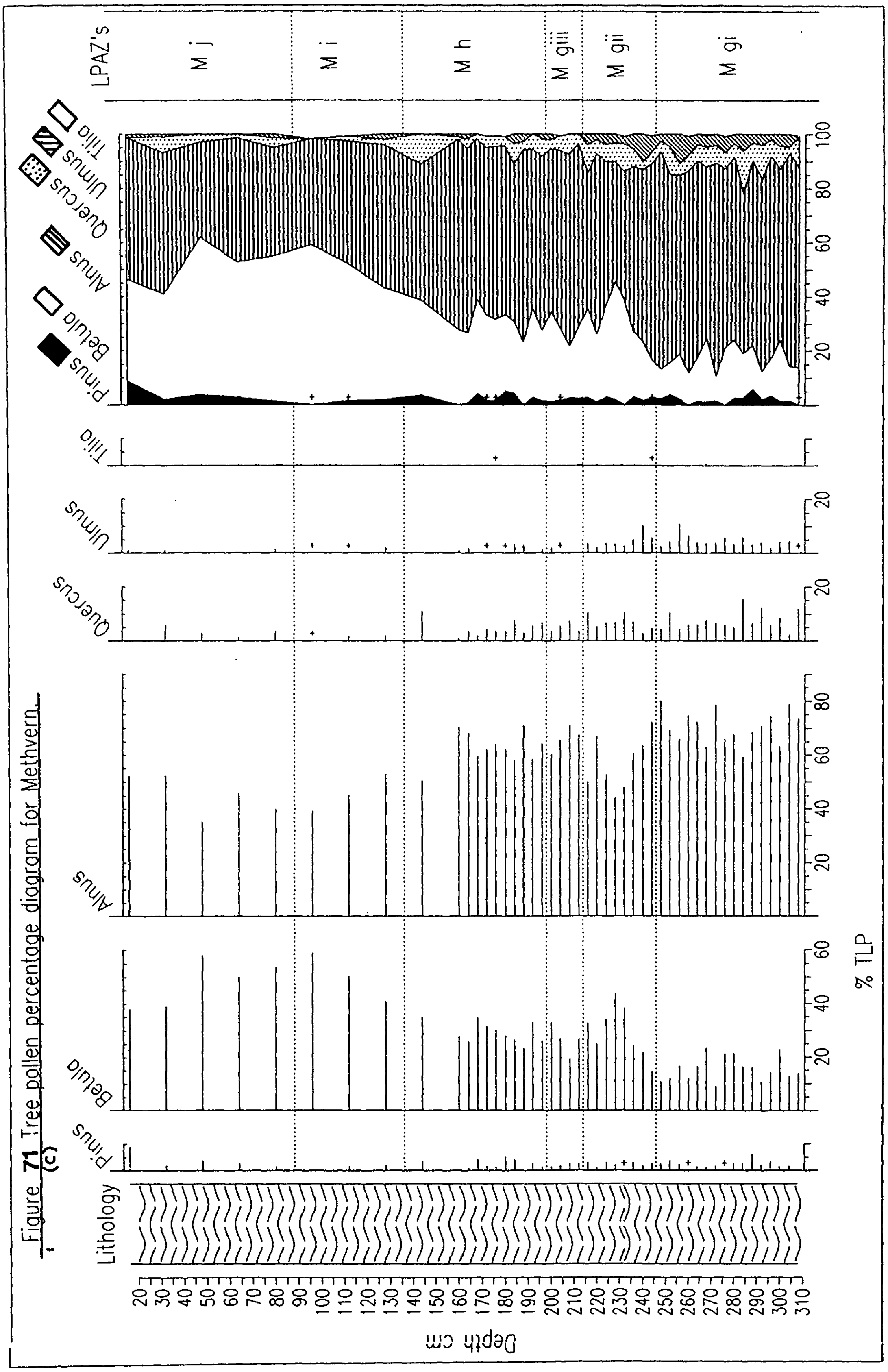


Figure 71 (c) Tree pollen percentage diagram for Methvern.

Figure **72** Pollen percentage diagram for Methvern.
(a)

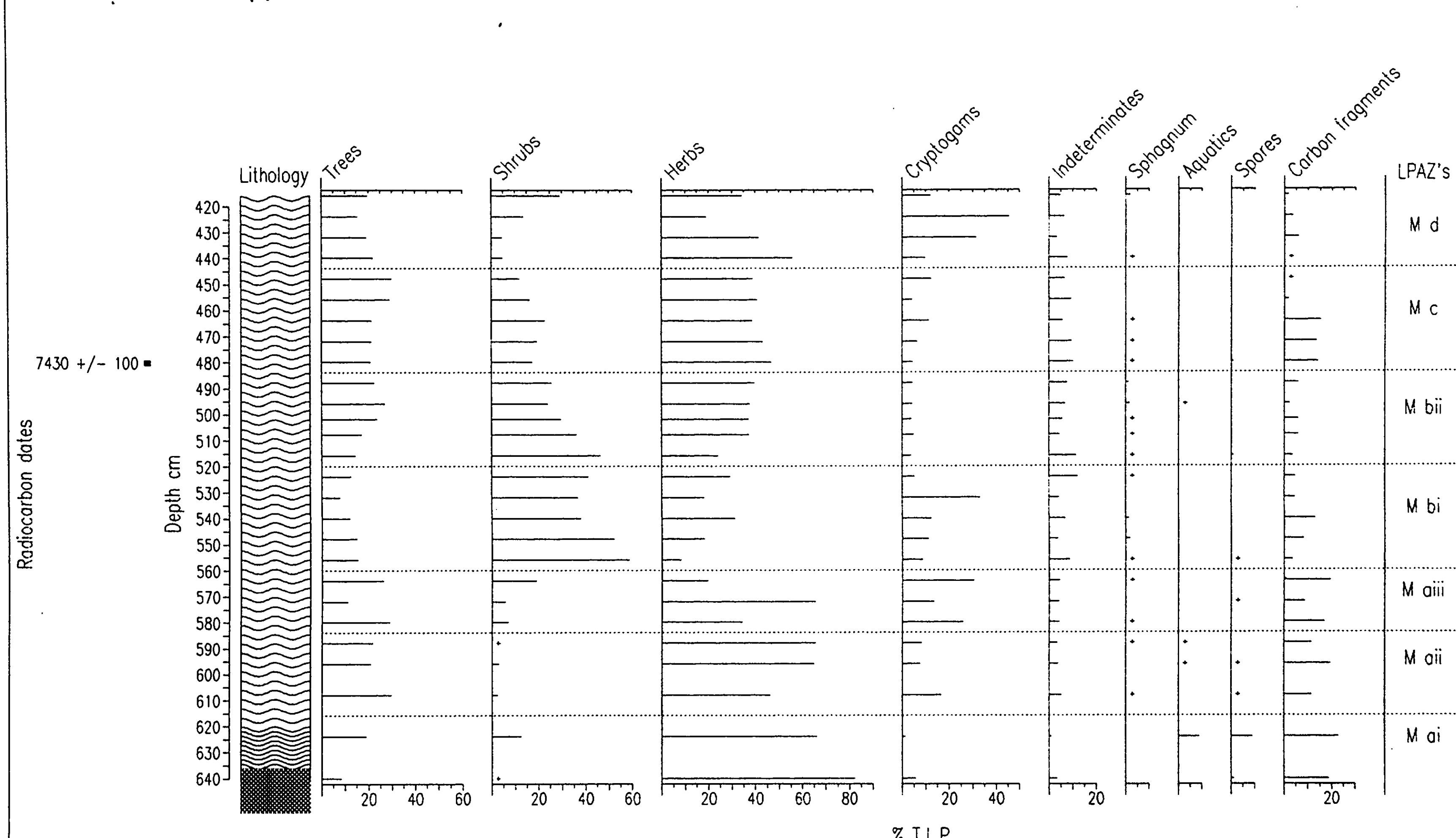


Figure **72** Pollen percentage diagram for Methvern.
(b)

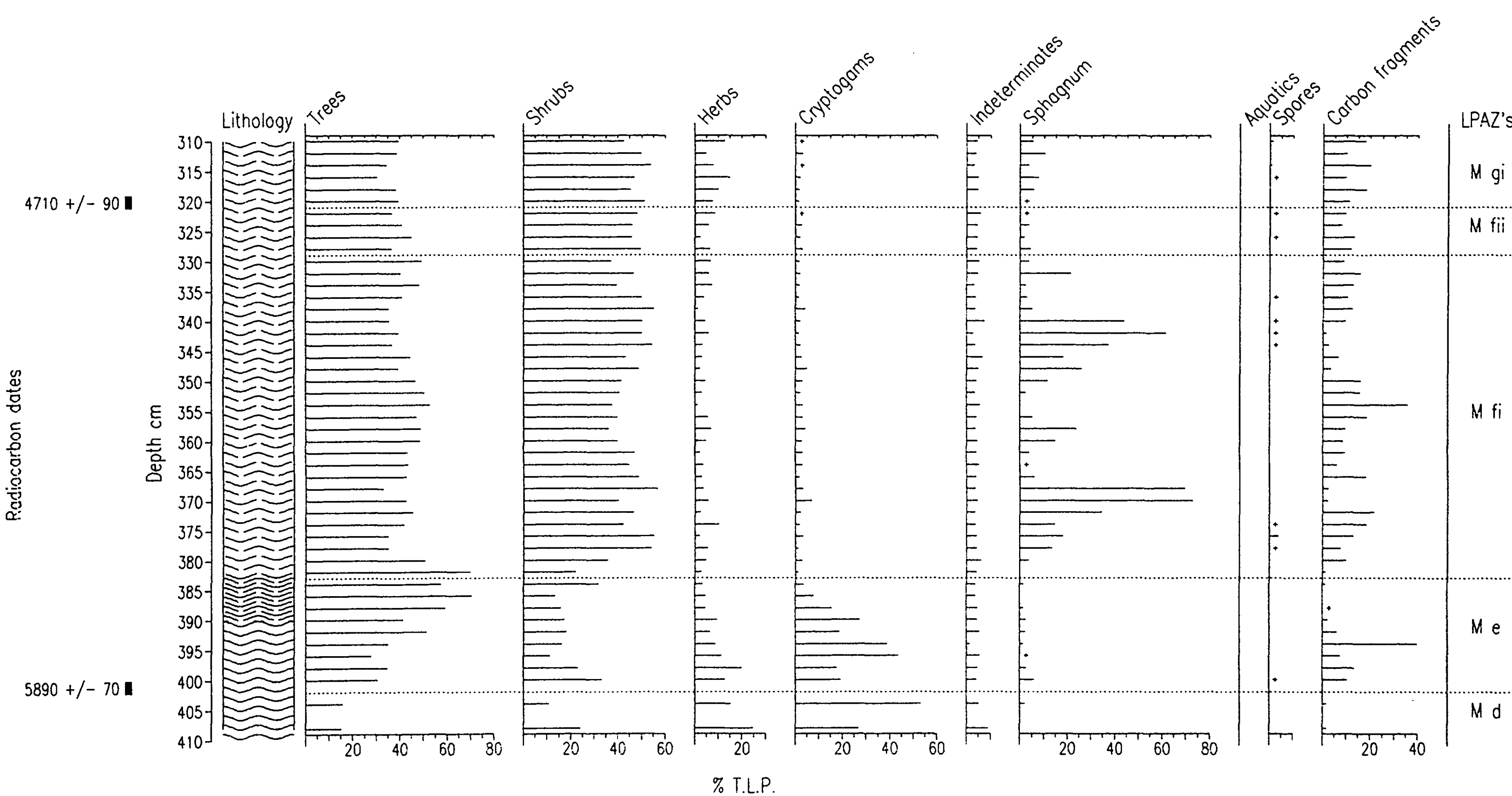
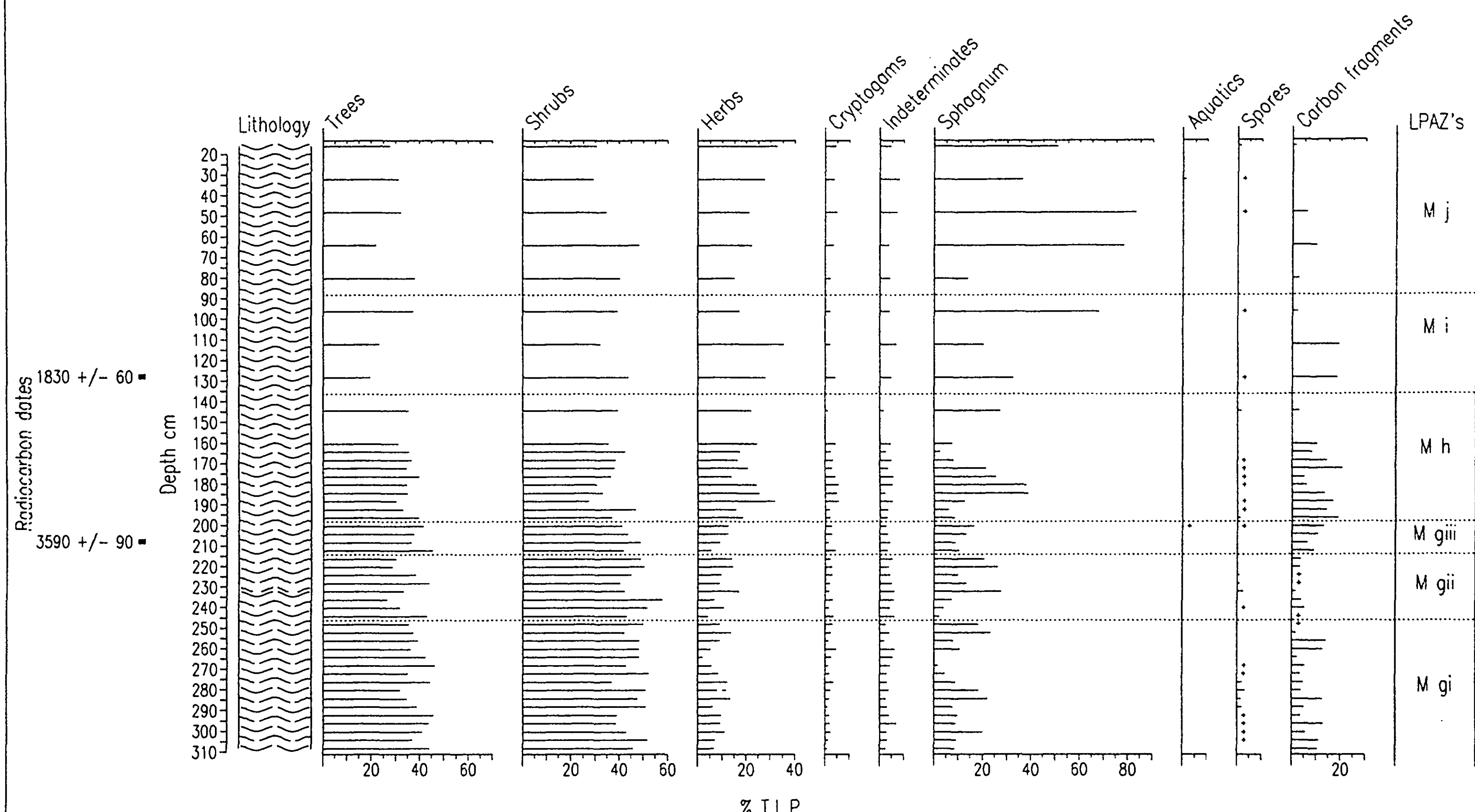


Figure 72 Pollen percentage diagram for Methvern.
(c)



7:6 - Vegetation history.

Throughout the following discussion a number of terms (after Bennett 1986a) are used to describe patterns of vegetation development as inferred from the pollen diagrams. 'Appearance' is defined as the intermittent occurrence of pollen grains of a particular taxon in the pollen record, but is not considered to indicate the presence of a local population of the taxon. 'Arrival' is defined as the first local presence of a taxon, and is recognised by the continuous presence, at low percentage values, of the pollen morphotype in the pollen record. 'Rise/expansion' is defined as an increase in the local population of a taxon, and is recognised by consecutive percentage increases in the representation of the taxon in the pollen record. 'Spread/range expansion' is defined as the movement of a taxon into and/or within a geographical area, and is recognised by variations in timing of the arrival and expansion of a given taxon in the pollen records from different locations within the study area.

7:6:1 - The Lateglacial to mid Holocene (ca. 10 530 to 5890 BP).

LPAZ Mai contains sediments which record the last stage of the Devensian late-glacial and the start of the Holocene period. The basal sediments at Methvern are comprised of pale grey silty clays which are characterised by low pollen concentrations (figure 59), low levels of organic matter (6 %) and a high percentage of poorly preserved pollen (figure 64), suggesting limited pollen production by a sparse plant community. The presence of mechanically damaged pollen indicates that pollen was undergoing transportation and suggests a generally unstable land surface. The range of pollen taxa recorded appears to reflect a landscape dominated by open grass and herb communities, the presence of *Thalictrum alpina* and *Koenigia islandica* pollen suggesting that conditions were both cold and disturbed (figure 65).

The presence of *Pinus* and *Betula* pollen at levels of 7 % and 3 % TLP at 640 cm are considered to represent the incorporation of long-distance wind transported pollen into the sedimentary record, rather than the presence of local populations within the pollen catchment. The relatively high values recorded are considered to reflect the limited pollen productivity of the local plant community.

A sharp transition between the basal clays and an amorphous peat is recorded at 636 cm (ca. 10 450 BP). The higher organic content, increased pollen concentrations and improvement in pollen preservation recorded in samples from this deposit are considered to reflect increasing sediment stability and increased pollen production by an expanding plant community. The disappearance of *Thalictrum alpina* and *Koenigia islandica* pollen from the record at 624 cm (ca. 10 220 BP) suggests a reduction in the amount of open ground and possibly an amelioration in climate. These taxa are at present most commonly located on rocky slopes in mountain regions of Scotland and north-west Europe (Clapham *et al.* 1989).

The increased representation of *Betula* pollen at 624 cm (19 % TLP) and its expansion to a peak of 28 % TLP at the start of LPAZ Maii (ca. 9910 BP) are considered to reflect its role as a pioneer coloniser of immature soils and the establishment and rapid expansion of a local population, as climatic conditions continued to improve in the period following deglaciation. The *Betula* rise is within the 10 000 BP isochrone proposed by Birks (1989) and is consistent with other dated sites in Central Scotland and Fife (Vasari 1977, Lowe 1977, Cundill and Whittington 1983, Whittington *et al.* 1990, Whittington *et al.* 1991).

The presence of Betula pollen at values of between 20 % and 28 % TLP throughout LPAZ Maii (ca. 9910 to 9380 BP) suggests that a birch woodland was developing at Methvern throughout this period. The continued high values of Gramineae pollen (up to 47 % TLP) and the range of herbaceous pollen taxa recorded suggest that the woodland canopy was not 'closed'. The presence of the aquatic taxa *Pediastrum* and *Menyanthes trifoliata*, *Sphagnum*, Cyperaceae and Filicales suggest that the coring site was located in an area of standing water and surrounded by a wetland community dominated by Cyperaceae. The Filicales recorded may have formed a fringe around the area of wetland or been part of the groundlayer in the developing *Betula* woodland.

The open *Betula* woodland appears to have been gradually colonised by *Corylus* from ca. 9380 BP (the start of LPAZ Maiii), but the limited increases in the representation of *Corylus* pollen in terms of pollen concentrations (figure 66) during LPAZ Maiii (ca. 9380 to 8890 BP) suggest that *Corylus* was forming only a minor constituent in the predominantly *Betula* woodland. The decrease in Gramineae pollen during the later half of LPAZ Maiii suggests that the woodland canopy was closing during this period.

Microscopic charcoal was strongly represented throughout LPAZs Mai to Maiii (figure 65).The high overall levels of charcoal recorded during this period may in part reflect the generally open landscape during the early Holocene. The absence of a closed woodland canopy limiting filtration and allowing charcoal from a wide source area to be incorporated into the sedimentary record. The peaks recorded during this early period are considered to probably represent charcoal generated by natural, lightning instigated fires, although on the basis of the available data the possibility that some fires were linked to anthropogenic activity can not be dismissed.

7:6:2 - The mid Holocene (ca. 8890 to 4810 BP).

The start of Mbi (ca. 8890 BP) marks the expansion of *Corylus* pollen at Methvern. This date is close to the 9000 BP isochrone proposed by Birks (1989), between those of the central Grampians (8700 BP - Birks and Mathewes 1978) and southern and south-western Scotland (9300 BP - Boyd and Dickson 1986) and within the range of dates recorded elsewhere in the study area (table 24). The possible influence of anthropogenic activity upon the spread of *Corylus* is discussed in Chapter Eight.

Table 24 The timing of the *Corylus* rise within the study area		
Date	Site	Author
9350 +/- 70 BP	Pickletillem	Whittington et al 1991
ca. 9000 BP	Black Loch	Whittington et al 1990
ca/ 8910 BP	Cruvie	Chapter 5 this thesis.
8449 +/- 85 BP	Creich Castle	Whittington et al 1990

Levels of *Corylus* pollen remain high (at greater than 40 % TLP) throughout LPAZ Mbi (ca. 8890 to 8110 BP) suggesting the presence of a mixed *Betula* / *Corylus* woodland. The continued low level representation of Cyperaceae pollen and *Sphagnum* spores indicates that the coring site remained an area of wetland; however, the absence of any aquatic pollen taxa from the majority of the zone (figure 65) suggests that there was little standing water during this period. Filicales and other cryptogams are strongly represented during this zone suggesting that they were growing close to the coring site and generally unaffected by the closing woodland canopy and increased pollen filtration. The generally low representation of herbaceous pollen taxa throughout LPAZ Mbi are considered to reflect the increase in woodland cover. At ca. 4870 BP (332 cm) Gramineae pollen values fall by 7 % TLP and *Betula* pollen values by 5 % TLP, whilst the representation of Filicales and *Thelypteris* spores increases. Examination of the pollen concentration diagram for this zone (figure 66) reveals a similar pattern of change suggesting that this fluctuation was not an artefact of the percentage calculation method. No changes are recorded in the sedimentary data or charcoal curve at 332 cm. On the basis of the available data it was not possible to identify the cause(s) or significance of these single level fluctuations. During LPAZ Mbi charcoal shows an overall decline in representation suggesting either a fall in the number of fire events during this period or increased filtration of microscopic charcoal as woodland density increased.

The start of LPAZ bii (ca. 8110 BP) marks the rational limit for *Ulmus* at Methvern. *Ulmus* pollen was present intermittently at < 1% TLP throughout LPAZ Mbi suggesting either the presence of a scattered *Ulmus* population, or the long-distance wind transportation of pollen from *Ulmus* woodland beyond the local catchment area. The date of ca. 8110 BP for the rational *Ulmus* limit is somewhat later than the 8500 to 9000 BP range proposed for eastern Scotland by Birks (1989), but is within the range of dates recorded at other local sites (table 25).

Table 25 The expansion of *Ulmus* within the study area.

Date	Site	Author
ca. 8500 BP	Black Loch	Whittington *et al.* 1990
8470 +/- 60 BP	Pickletillem	Whittington *et al.* 1991
ca. 7870 BP	Pitbladdo	Chapter 6 this thesis.
ca. 7650 BP	Cruvie	Chapter 5 this thesis.

Ulmus values remain at less than 5 % TLP until approximately 5700 BP suggesting that *Ulmus* formed only a minor woodland constituent in the area surrounding Methvern during the mid-Holocene period. The rational limit for *Quercus* occurs at ca. 7570 BP, approximately 600 to 700 years after that of *Ulmus*, mirroring the sequence of arrival recorded at other local high resolution sites (Whittington *et al.* 1990, 1991). The arrival of *Quercus* falls within the 7000 to 7500 BP isochrone proposed by Birks (1989) and within the range recorded at other local sites (table 26).

Table 26 The expansion of *Quercus* within the study area.

Date	Site	Author
ca. 8500 BP	Black Loch	Whittington *et al.* 1990
7880 +/- 60 BP	Pickletillem	Whittington *et al.* 1991
ca. 7870 BP	Pitbladdo	Chapter 6 this thesis.
ca. 6990 BP	Cruvie	Chapter 5 this thesis.

During the period of ca. 8110 to 7430 +/- 100 BP (LPAZ Mbii) the area surrounding Methvern appears to have supported a mixed woodland, in which *Betula* and *Corylus* formed the dominant and *Ulmus* and *Quercus* the minor taxa. The representation of Gramineae and Cyperaceae pollen remains generally stable suggesting the continued presence of areas of open land. It is suggested that Gramineae and Cyperaceae may have dominated the wetland area immediately adjacent to the site, which the arboreal and shrub taxa were unable to colonise successfully, resulting in the strong and stable values recorded. Examination of the pollen concentration diagram (figure 66) indicates that the decline in *Corylus* recorded during LPAZ Mbii is primarily a reflection of the percentage method of calculation.

The period of 7430 +/- 100 to 6630 BP (LPAZ Mc) was one of mixed *Betula* and *Corylus* woodland in which *Ulmus* and *Quercus* were minor constituents. The representation of *Corylus* values declined in both absolute and percentage terms culminating in a low of 5 % TLP at ca. 6630 BP. The decline in *Corylus* pollen might indicate a decline in the *Corylus* population, a decrease in *Corylus* pollen productivity or possibly increases in pollen filtration by canopy trees. The generally stable representation of arboreal taxa during LPAZ Mc (figure 72) suggests that no extensive woodland clearance occurred during this period, and it is considered unlikely that a human population would have initially removed a useful food source from the area. The possibility of a decrease in the pollen productivity of *Corylus* is considered feasible, although there are no indications of substantial changes in either the sedimentary or palynological record that might be related to this reduction. During the period of the decline in *Corylus*, increases were recorded in the representation of *Ulmus* pollen during LPAZ Mbii and *Quercus* pollen during LPAZ Mc. The establishment of these canopy trees may have led to an increase in pollen filtration, resulting in a decline in the representation of pollen from smaller canopy and understorey taxa, such as *Corylus*. On the basis of the available data it is not possible to determine the validity of these proposals, and the cause of this decline remains unclear.

Pinus pollen values increased from 5 % TLP to 13 % TLP during LPAZ Mc. The size of the site at Methvern and the central position of the coring site suggest that approximately 70 % of pollen recovered from Methvern may have had a regional source (based on Jacobson and Bradshaw 1981), and it is suggested that the increase in *Pinus* pollen may reflect the establishment of *Pinus* in the upland areas of Perthshire to the north of Methvern.

Gramineae pollen values fluctuated slightly but remained high, whilst herbaceous taxa tolerant of disturbed conditions continued to appear intermittently, with *Rumex* reaching > 1% TLP for the first time. The high levels of Gramineae pollen are considered predominantly to reflect an open area unsuitable for woodland colonisation in the area surrounding the coring site, although the presence of taxa indicative of disturbed conditions may reflect the presence of disturbed open areas within the established woodland. During the first half of LPAZ Mc a series of peaks in microscopic charcoal occurred. These peaks appear to have had little overall impact on the vegetation composition of vegetation within the pollen catchment and may reflect distant fire events. However, the presence of low levels of Ericaceae and *Pteridium* suggest the presence of localised heathland, which may have been developing in response to fire events.

During LPAZ Md (ca. 6630 to 5890 BP) the values of all the major pollen taxa fluctuate considerably. It is suggested that these oscillations are reflecting changes in vegetation composition, primarily relating to the establishment and decline of open spaces, close to the coring site. On the basis of the available evidence it is not possible to determine if these changes are reflecting :

i) Natural patterns of growth and decay within the woodland mosaic (wind-throw, disease, lightning and natural death), leading to the creation of temporary openings in the canopy.

ii) The creation and abandonment of clearings by humans on a shifting basis.

iii) Fluctuations in the local water-table, reflecting variations in climate, resulting in changes in vegetation composition.

iv) A combination of the above.

The peak in Gramineae and *Corylus* values at ca. 6160 BP (416 cm) corresponds to a decline in Cyperaceae. This could be interpreted as indicating a drier phase during which Gramineae and *Corylus* encroached onto areas closer to the coring site. However, the fall in Gramineae and

Corylus values between ca. 6160 to 5890 BP does not correspond to an increase in Cyperaceae suggesting that a simple cause / effect model is not applicable. A further feature of the LPAZ is the low level of microscopic charcoal recorded, suggesting that fires, either natural or anthropogenically instigated, were limited during this period. The possibility that the changes recorded in LPAZ Md reflect human activity is discussed further in Chapter Eight.

The last of the arboreal pollen taxa to arrive at Methvern was *Alnus*. *Alnus* was present at < 1% TLP in all of the samples between ca. 8900 to 6160 BP rising to 2% TLP from ca. 6000 BP prior to its expansion at 5890 +/- 70 BP (the start of LPAZ Me). The expansion of *Alnus* at this site is later than both the 6500 to 7000 BP isochrone predicted by Birks (1989) and the dates recorded for this event at other sites within the study area. The late expansion of *Alnus* at Methvern is considered to reflect local environmental conditions (discussed further in Chapter Eight).

During LPAZ Me (5890 +/- 70 to 5600 BP) the levels of Gramineae pollen recorded are lower (< 15 % TLP) than in earlier LPAZs, the levels of Filicales spores recorded are very high (20% to 70% TLP) and an overall increase is recorded in the representation of *Betula* pollen. The changes in the representation of these taxa during this period suggest that LPAZ Me represents a transitional phase, during which the area under investigation changes from a bog dominated by Gramineae and Cyperaceae to an ombrotrophic raised bog dominated by Ericaceae and *Sphagnum*. The absence of pollen from obligate aquatic taxa during the majority of this zone suggest that conditions were predominantly dry and it is suggested that Filicales may have colonised the area surrounding the coring site during this period. The change in sediment stratigraphy during this period from an amorphous brown peat to a compacted *Sphagnum*-rich peat at 390 cm supports the proposal that the ecology of the site was changing during this period. The band of compacted *Sphagnum* peat between 390 cm to 382 cm corresponds to an increase in pollen concentrations (figure 59), suggesting that sediment deposition slowed during this period.

The increase in *Betula* pollen during LPAZ Me may reflect the expansion of *Betula* at the edges of the site. Alternatively the changes recorded in this LPAZ may in part reflect changes in woodland composition during this period. It is tentatively suggested that humans may have been establishing and maintaining localised clearances during LPAZ Md, and that a fall in the intensity of anthropogenic activity during LPAZ Me resulted in woodland regeneration, primarily by *Betula* and then by *Corylus*. The continued if sporadic appearance of herbaceous taxa tolerant of disturbed conditions suggests that humans may have continued to have been active throughout this period, but that the focus of their activity had shifted outside of the pollen catchment and was therefore having little impact on the palaeoenvironmental record at this site. On the basis of the available data it is not possible to determine the extent to which human activity influenced the environment during this period and the sequence of events outlined above remains speculative.

The start of LPAZ Mfi corresponds to a fall in the representation of *Betula* pollen and an increase in *Corylus* values. This change may reflect the replacement of *Betula* by the more competitive *Corylus* within formerly open areas. The period between ca. 5600 to 4810 BP (LPAZ fi) is characterised by a mixed deciduous woodland in which there are no major shifts in vegetation. Considerable fluctuations in micro-charcoal are recorded throughout this period but there are no clear correlations between changes in vegetation and charcoal peaks and it is not considered possible to identify the factor(s) that instigated these fires. Increases in the representation of Ericaceae and *Sphagnum* at the start of this LPAZ are considered to reflect the establishment of a *Sphagnum* / Ericaceae community in the vicinity of the coring site. The pattern of peaks and troughs recorded in the Ericaceae and *Sphagnum* curves during the remainder of the sedimentary record are considered to reflect the development of a hummock-and-hollow system, leading to periodic changes in the dominant bog taxa close to the coring site (figure 67).

The low levels of Gramineae and herbaceous taxa tolerant of disturbance suggests that human activity in the local area was minimal during this period, or was effectively masked in the palaeoenvironmental record by the dense woodland canopy, which would have acted as an effective pollen filter. A small *Ulmus* decline (12 % to 6 % TLP) is recorded at ca. 5160 BP (352 cm) but no significant changes are recorded in other pollen curves or sedimentary data at this level and on the basis of the available evidence it is not possible to determine either the cause or significance of this event. Despite the limited evidence for anthropogenic activity during this period the occurrence of cereal-type pollen (*Hordeum* type) at 340 cm (ca. 4990 BP) suggests that arable agricultural activity was being carried out in the local area surrounding Methvern.

7:6:3 - The mid to late Holocene (ca. 4810 BP to 20 BP).

At Methvern the major decline in *Ulmus* occurs during LPAZ Mfii (ca. 4810 and 4710 BP) and values of *Ulmus* pollen decline from 9 % TLP at ca. 4780 BP to less than 1 % TLP at ca. 4710 BP. This date is later than the 'classic' *Ulmus* declines recorded at other local sites (table 27). The dates recorded at these sites are closer to the minor decline recorded in *Ulmus* pollen at ca. 5160 BP (LPAZ Mfi); however, the recovery in *Ulmus* pollen values between ca. 5160 BP and ca. 4780 BP indicate that the later date represents the definitive *Ulmus* decline at Methvern.

Table 27 The *Ulmus* decline within the study area.

Date	Site	Author
5240 +/- 80 BP	Pitbladdo	Chapter 6 this thesis
5180 +/- 80 BP	Black Loch	Whittington *et al.* 1990
ca. 5100 BP	Pickletillem	Whittington *et al.* 1991
ca. 4970 BP	Cruvie	Chapter 5 this thesis

In the period spanning the *Ulmus* decline no significant variations are recorded in the other pollen curves, charcoal values remain stable and there are no visible changes recorded in the sedimentary data. It is considered that whichever agent was responsible for the *Ulmus* decline at this site it was solely affecting *Ulmus*. The absence of other changes during this phase leads to the suggestion that at this site a pathogenic attack may be the most plausible explanation for the decline in *Ulmus*.

The period between ca. 4710 and 3940 BP (LPAZ Mgi) represents a continuation of the mixed woodland established in LPAZ Mf (excluding *Ulmus*). However, the fluctuations in arboreal taxa and the increased range of herbaceous taxa, suggest an increase in human activity in this area during the Neolithic period. The nature of this activity is difficult to determine. The absence of any substantial increases in Gramineae pollen values appears to indicate a lack of open areas, which could have indicated possible pastoral activity, within the woodland. However, it is recognised that agricultural activity may have been practised during this period and remained largely 'invisible' in the palynological record, owing to pollen filtration by the plant communities located between the area of activity and the site under investigation.

During LPAZ Mgi a series of peaks is recorded in the microscopic charcoal curve (figure 69). However, there are no clear correlations between the charcoal peaks and changes in vegetation and it not possible to ascertain if these peaks reflect natural or anthropogenically instigated fire events. The sedimentary data for this period shows no evidence of changes that might be attributed to human activity. On the basis of the available data it is suggested that, although there appears to have been an increased level of environmental disturbance during this period, there is no significant evidence of agricultural activity in the immediate vicinity of Methvern. Activity in the local area may have primarily involved the utilisation of resources within the woodland environment rather than widescale modification of the landscape for agricultural purposes.

During LPAZ gii (ca. 3940 to 3620 BP) an increase in the range of herbaceous taxa combined with fluctuations in arboreal and shrub pollen taxa (figure 69) suggest continued human activity. During this period *Alnus* values fall by approximately 10 %, whilst *Betula* values increase by 5 to 10 % TLP. It is suggested that this may reflect the clearance of *Alnus* to create open areas and the colonisation of the edges of these areas by opportunistic, light-loving *Betula*. Gramineae values fluctuate considerably but remain generally low, suggesting that clearances are located in areas on the periphery of the pollen catchment, or obscured owing to pollen filtration. Levels of microscopic charcoal are also low during this zone suggesting that any activity did not involve the extensive use of fire, although it is considered possible that the low levels of charcoal recorded may reflect the use of fire for domestic purposes by a local human population.

During LPAZ Mgiii (ca. 3620 to 3300 BP) the number of herbaceous taxa associated with disturbed conditions falls slightly, whilst the return of *Alnus* to its former levels at ca. 3620 BP may reflect the re-establishment of *Alnus* in an area in which human activity has ceased. The occurrence of cereal-type pollen (*Hordeum* type) at the end of this zone (ca. 3440 BP) indicates that arable agriculture was being undertaken in the Methvern area during the Bronze Age. However, the continued low representation of Gramineae pollen during this period suggests that either no widescale clearances were created in the local area surrounding the site, or that arboreal taxa close to the site were filtering out the majority of the herbaceous pollen taxa.

Between ca. 3300 to 2950 BP, the first half of LPAZ Mh, a sharp increase is recorded in the representation of Gramineae pollen, both absolute and percentage, with values increasing from 4 % TLP at the end of LPAZ giii to a maximum of 18 % TLP at ca. 2950 BP. A fall of 10 % TLP is recorded in Gramineae values at ca. 2860 BP, before a slight recovery in values between ca. 2860 and 2160 BP. The absence of cereal-type pollen from this LPAZ may reflect an entirely pastoral agricultural base or be due to the limited pollen production and transportation properties of cereal pollen. High levels of microscopic charcoal are recorded throughout the majority of this zone. A fall in the representation of charcoal at ca. 2860 BP corresponds to the reduction in Gramineae pollen and suggests that fire may have been used as a means of land management by the human population during this period. Overall levels of arboreal and shrub pollen taxa fall only slightly during this zone and it is suggested that these values reflected the continued presence of an area of woodland at the margins of the study site.

Between ca. 1830 to 1620 BP (the start of LPAZ Mi), a 7 % increase in the representation of Gramineae pollen and a fall in both the absolute and percentage levels of arboreal and shrub pollen taxa is recorded. The increase in Gramineae pollen corresponds to the presence of cereal-type pollen (*Hordeum* type) and it is suggested that these changes reflect the practice of arable / pastoral agriculture in the vicinity of Methvern. The peaks in microscopic charcoal recorded during this period may reflect the use of fire in maintaining areas used for agriculture, although the possibility of naturally instigated fires is not dismissed. The increase in levels of Ericaceae pollen (up to 20 to 30 % TLP) suggests an increase in the representation of heathland during this period, and it is suggested that although some of this may reflect Ericaceae located on the bog surface, Ericaceae might also be becoming established within the general landscape, possibly in areas that have been subjected to fires or on the fringes of agricultural land.

In the period between ca. 1620 BP and 1160 BP (the LPAZ Mi / Mj boundary) an increase in the representation of *Betula* and *Alnus* pollen, concurrent with a fall in the representation of Gramineae pollen and a fall in the levels of microscopic charcoal, suggests that the level of agricultural activity may have decreased slightly during the early medieval period. However, the presence of cereal-type pollen at the end of this period (ca. 1160 BP) suggests that some arable cultivation was occurring and it is possible that the changes recorded reflect a local increase in arboreal taxa rather than large-scale woodland regeneration.

From ca. 930 BP (LPAZ Mj) there appears to have been a resurgence in activity which continues throughout the medieval and historic periods. It is considered that the increased representation of Gramineae and the sporadic occurrence of cereal-type pollen (*Hordeum* type) pollen reflects a pattern of continuous local agricultural activity. It is suggested that the peak in mineral matter recorded at ca. 720 BP (50 cm) may represent the deposition of wind-blown material from cultivated fields located in the vicinity of Methvern. However, on the basis of the available evidence, this proposal remains speculative.

The continued presence of *Betula*, *Alnus* and *Corylus* pollen at greater than 10 % TLP is considered to reflect the presence of a woodland fringe surrounding the *Sphagnum*-dominated raised bog from which this palaeoenvironmental record was extracted.

Part Three: Discussion and conclusions.

Chapter Eight - A select discussion of the palaeoenvironmental evidence.

8:1 - Climate change.

8:1:1 - Introduction.

The reconstruction of past climate based upon palaeoenvironmental data has been undertaken for a number of time periods, using a range of climatic indicators. Palynology has formed one of the key methods in the investigation of long-term patterns of climate change, and the response of vegetation to major shifts in climate is one of the main tools employed in the unravelling of the terrestrial palaeoenvironmental record of glacial-interglacial cycles (e.g. West 1985). The climatic oscillations of the closing phases of the Devensian have also been the subject of intensive study (e.g. Lowe 1978; Walker and Lowe 1982, 1990; Tipping 1991). The recognition of climate change during the Holocene is more complex, and the impact of climatic oscillations on patterns of vegetation development is a matter of debate (Huntley 1993, Lowe 1993). It has been argued that climatically this period appears to have been relatively stable, with only minor oscillations, which had only marginal effects on the prevailing biota (cf. Lowe, 1993). However, Huntley (1993) has proposed that climatic fluctuations during the early Holocene may have provided significant controls on rates and patterns of vegetation development following deglacitation, in particular in relation to the spread of *Corylus*. At present the overall impact of climatic fluctuations on vegetation development during the early post-glacial remains unclear. In addition the potential impact of human activity on the palaeoenvironmental record during the Holocene introduces an additional variable not previously encountered.

"Periods of human activity may or may not have coincided with periods of climatic changes and may have influenced the vegetation as much as climatic changes can or actually have done" (Harding 1982 p.85).

Before the development of palynology the study of peat bog stratigraphy formed the main source of information for Holocene climate change (Birks and Birks 1980). The variations in decomposition recorded in peat bogs were attributed to variations in climatic conditions. Until fairly recently the Blytt-Sernander scheme (table 28), based upon changes in a number of variables, including bog stratigraphies, was generally used as a guide to Holocene climate change.

Table 28 The Blytt-Sernander sequence of Holocene climatic episodes

(After Bell and Walker 1992).

Years before present	Blytt-Sernander period	Climate
1000 2000	Sub-Atlantic	Cold and wet
3000 4000 5000	Sub-Boreal	Warm and dry
6000 7000	Atlantic	Warm and wet
8000 9000	Boreal	Warm and dry
10000	Pre-Boreal	Subarctic

The broad climatic divisions suggested by Sernander, which did not recognise the importance of site specific responses to change, could not be linked to synchronous changes in vegetation and bog stratigraphy, on the basis of radiocarbon dating leading to the suggestion that "the point has come when the simplistic concepts of the Blytt-Sernander scheme must surely be banished forever" (Smith 1981 p.143).

In recent years several researchers have developed methods of reconstructing proxy-climate records, based on stratigraphic changes within bog systems (Aaby 1976, Barber 1982, Barber *et al.* 1994, Tipping 1995). These methods incorporate, the analysis of changes in the representation of macrofossils, pollen and levels of vegetational decay within the stratigraphic record; these changes are then correlated using tight radiocarbon dating controls. In addition to the pollen-stratigraphic evidence a range of palaeoclimatic indicators has been used to assess Holocene climate change, including tree-rings, lichen growth, varves, glacier fluctuations (Lamb 1977), deuterium isotope analysis of pine stumps (Dubois and Ferguson 1985), occurrence and distribution of Coleoptera (Coope and Lemdahl 1995), lake-level fluctuations (Harrison and Digerfeldt 1993) and oxygen isotope measurements (Whittington *et al.* 1996).

Recent work by Taylor *et al.* (1993) and Whittington *et al.* (1996) has indicated that the start of the present interglacial occurred very rapidly, and that the 'climatic optimum' was reached during the first 1000 years of the Holocene (Kutzbach and Guetter 1986). The study of fluctuations in lake-levels at various sites in Europe (Harrison and Digerfeldt 1993, Tipping 1993, O'Sullivan 1975, Mannion 1982, Digerfeldt 1988) appears to suggest a number of shifts between a predominantly wet or dry climate throughout the Holocene period. A dry phase at approximately 9000 BP is proposed by a number of workers including Lowe (1993), Magny (1992) and Tipping (1993); with a second period of increased dryness after 8000 BP, although there is considerable variation between workers on the timing of this episode (see O'Sullivan 1975, Tight 1987, Digerfeldt 1988). On the basis of this emerging evidence it is clear that considerable uncertainties exist as to both the nature and timing of climate changes during the Holocene.

8:1:2 - Evidence for climate change at the sites under investigation.

The reconstruction of Holocene palaeoclimates was not an initial aim of this project and specific analyses designed to reveal potential climatic variations were not undertaken. However, the potential impact of climatic changes on vegetation development at the sites under investigation is recognised. The limited evidence relating to possible climate signals, recorded at the three sites under investigation, is based upon apparent changes in site hydrology and peaks in fire events. These changes are compared to the classic climatic divisions and the findings of other recent researchers.

It is proposed that any climatically induced change could be expected to display a degree of synchroneity between sites, given the limited size of the study area, particularly during the early Holocene when human activity is not considered to have been extensive. It is suggested that site-specific changes are likely to be attributable to local variations in hydrology and fire regimes.

For the purposes of this project the palaeohydrology of each site was assessed primarily upon the presence or absence of pollen of aquatic plants recorded within the general pollen record. As Methvern is a raised bog site and contains only sporadic aquatic taxa it is excluded from this assessment, although its potential as a source of climatic data is not disputed. Changes in water-depth were estimated from the present requirements of each of the aquatic taxa recorded (See table 29).

Table 29 Range of water depths acceptable to each of the main aquatic taxa recorded.
(After Rieley and Page 1990).

Group	Taxa	Water depth
1	None	
2	*Sphagnum*	Surface
3	*Nymphaea*	> 1m - < 3m
3	*Nuphar*	> 1m - < 3m
4	*Myriophyllum* spp.	< 1m
4	*Potamogeton*	< 1m
4	*Callitriche*	< 1m (fluctuating)
5	*Typha latifolia*	0.2 - 2m
5	*Sparganium* sp.	0.2 - 2m

It is proposed that changes in the representation of aquatic taxa within the pollen record may be used as a guide to changes in water depth. However, it is recognised that this method provides only a rough guide to changes in water-depth and the subsequent inferences are considered to be tentative

Table 30 Presence / Absence of Aquatic taxa groups for Pitbladdo and Cruvie.

Pitbladdo

Depth in cm	Group 1	2	3	4	5
1		x			
8		x			x
16		x	x	x	x
24			x	x	x
32			x	x	x
40		x	x	x	
48			x	x	x
56		x	x	x	x
64		x	x	x	x
72		x	x	x	
80		x	x	x	
88		x	x	x	
96		x	x	x	x
100		x	x	x	x
108			x	x	x
116		x	x	x	x
124			x	x	x
132		x	x	x	x
140			x	x	x
148			x	x	x
156			x	x	
164			x	x	x
172		x	x	x	x
180		x	x	x	x
188			x	x	x
196			x	x	
200		x	x	x	
208			x	x	x
216		x	x	x	
224			x	x	x
232		x	x	x	
240		x	x		
244			x	x	
248		x	x	x	
252			x	x	
256		x	x		
260			x	x	
264			x	x	
268				x	
272		x	x	x	
276		x		x	
280		x	x	x	
284				x	x
288		x	x	x	
292		x	x	x	
296			x	x	
300		x	x	x	
302		x	x	x	

Depth in cm	Group 1	2	3	4	5
304		x	x	x	x
306			x	x	
308			x	x	
310				x	
312			x		
314			x	x	
316			x	x	
318			x	x	
320			x	x	x
322		x	x	x	
324			x	x	
326				x	
328			x	x	x
330			x	x	
332		x	x	x	x
334				x	
336			x	x	
338		x	x	x	
340			x	x	
342			x	x	
344			x		
346		x	x	x	
348				x	
350		x	x	x	
352			x	x	
354			x	x	
356		x	x	x	
358			x	x	
360			x	x	
362		x	x	x	
364		x	x	x	x
366			x		x
368			x	x	x
370			x		
372			x	x	
374			x	x	
376			x	x	
378	x				
380			x	x	
382			x	x	
384			x	x	
386		x	x	x	
388		x	x	x	x
390			x		x
392			x	x	x
394			x		
396			x	x	
398			x	x	

Depth in cm	Group 1	2	3	4	5
400			x	x	
402	x				
404			x	x	
406			x	x	
408		x	x	x	
410		x		x	
412			x		
414			x	x	
416				x	
418			x	x	
420				x	
422			x	x	
424		x	x	x	
426		x		x	
428				x	
430				x	
432			x	x	
434				x	
436			x	x	
440				x	
444				x	
448			x	x	x
456				x	
464			x	x	
472		x	x	x	x
480		x		x	x
488		x			x

Cruvie

Depth in cm	Group 1	2	3	4	5
10	x				
26				x	
40	x				
56				x	
72			x		
88			x		
104			x	x	x
120			x	x	
136			x	x	
152			x	x	
168			x	x	
184			x	x	x
200			x		
216			x	x	
232		x			
248	x				
264	x				
280	x				
296			x	x	
312					x
328	x				
344			x	x	
360	x				
376		x			
392	x				
402					x
424					x
440		x			
456	x				
472	x				
488	x				

Group	Taxa	Water depth
1	No taxa	
2	*Sphagnum*	Surface
3	*Nymphaea*	> 1m - < 3m
3	*Nuphar*	> 1m - < 3m
4	*Myriophyllum spp.*	< 1m
4	*Potamogeton*	< 1m
4	*Callitriche*	< 1m (fluctuating)
5	*Typha latifolia*	0.2 - 2.0m
5	*Sparganium sp.*	0.2 - 2m

and open to revision. Table 30 shows the distribution of the main aquatic taxa at both Cruvie and Pitbladdo. Figure 73 shows the proposed changes in water-depth at each site.

The potential links between climate and the representation of microscopic charcoal are also considered in this section. Changes in the abundance of microscopic charcoal provide a record of changes in the relative importance of fire over time. However, this record does not indicate causal factors and the distinction between 'natural' lightning-instigated fires and 'anthropogenic' fire signals is at best inferred. Interpretation of the charcoal record is hampered due to our current limited understanding of the sources of the microscopic charcoal recovered (Clark 1988) and the effect that variations in site characteristics may have on charcoal representation (Tolonen 1986). The impact of variations in the size and intensity of fires and the nature of the plant communities burnt, e.g. woodland versus grassland, is also not presently fully understood.

In addition the charcoal record recovered from each of the sites under investigation is in part determined by the sampling interval used by the analyst, and in part by the sedimentation rate occurring at each site. The levels of charcoal recorded are not a reflection of single events, but rather indicate general trends.

It is considered that our limited understanding of both the mechanisms that determine the frequency and nature of fires in modern woodland environments, and the mechanisms determining the production, distribution and deposition of charcoal, form a limited basis for the interpretation of past fire regimes, and the arguments outlined below are considered to be provisional.

It is proposed that climatically induced fires might be expected to occur more frequently during drier climatic periods, the classic Boreal and Sub-Boreal, than during wetter episodes, the classic Atlantic and Sub-Atlantic, and that increases in the abundance of microscopic charcoal may be considered to reflect an increase in either the size or number of fire events. The work of Clark (1988 p.233) supports this: "Charcoal data indicate that fire regimes corresponded to climatic changes of the past few centuries ... Charcoal was most abundant when warmer, drier conditions prevailed."

It is proposed that any climatically induced changes in fire regimes are likely to be recorded across the study area, particularly during the early Holocene. It is recognised that it may not be possible to determine whether fire events were instigated by climatic, anthropogenic or a combination of causal factors. Microscopic charcoal was recorded at all three sites throughout the Holocene; however, as the levels of charcoal recorded at Cruvie remained low and relatively stable, Cruvie was omitted from this assessment. Tables 31 and 32 show the levels at which charcoal peaks were recorded at Pitbladdo and Methvern and the estimated time interval between major fire events.

8:1:3 - Phases of increased dryness.

Changes in the representation of aquatic taxa in the palynological record from Pitbladdo and Cruvie indicate that water levels at both sites fluctuated and that significant falls in water levels occurred at least 19 times at Pitbladdo and 9 times at Cruvie (see figure 73). 'Significant' is defined as a change sufficiently large and/or of long enough duration to result in changes in plant distribution.

Table 31 Peaks in microscopic charcoal recorded at Methvern.

Depth in cm.	Estimated date in years B.P.	Cumulative event years	Time interval between events	*
64	930		686	
112	1620	214	214	
128	1830		946	
172	2780		528	
196	3300		756	
256	[4060	40	40	*
260	4100]		240	*
284	4340		120	
296	4460		80	
304	[4540		40	*
308	4580	60	20	
310	4600]		40	
314	4640		40	
318	4680		525	
354	5210		161	*
366	5370		87	
372	5450		339	
394	5770		1324	
464	[7100		156	
472	7250	332	176	
480	7430]		1150	
540	8580		468	
564	9050		331	
580	9380		292	
596	9670		546	
624	[10220	312	312	
640	10530]			

Table 32 Peaks in microscopic charcoal recorded at Pitbladdo.

Depth in cm.	Estimated date in years B.P.	Cumulative event years	Time interval between events	*
8	[3920		21	
16	3950	42	21	
24	3970]		85	
56	[4050		19	*
64	4070	38	19	*
72	4090]		141	*
124	4230		290	
196	4520		610	*
312	5130		44	
320	5170		22	
324	5200		22	
328	5220		1960	*
428	7180			

[ ] indicates fire events recorded at consecutive sampling horizons. * indicates cross site correlation.

It is proposed that the differences between the two sites may in part reflect the sensitivity of the individual sites to changes in the environment and in part the type of events that were creating the changes recorded. Joos (1982) argued that changes in lake-levels may be attributed to three factors:
Geological factors: Producing short-lived rises in levels, due to landslides, river deviation.
Anthropogenic influences: Increasing levels due to land clearance, of variable scale and duration.
Climatic changes: Producing fluctuations in levels on a supraregional scale.

The impact of either geological or anthropogenic influences could well be spatially limited and result in the variable number of site-specific responses. Alternatively the coarser sampling interval and poorer temporal resolution at Cruvie (an average of 200 years duration between consecutive levels, in contrast to the average of 30 years at Pitbladdo) resulted in a less sensitive picture of change and the smaller number of fluctuations recorded at Cruvie may in part reflect this relative lack of temporal clarity.

Tables 33 and 34 show the phases of declining water levels as suggested by changes in the occurrence of aquatic taxa (see table 30) in relation to changes recorded in other selected variables. The tables clearly show that each 'dry phase' has a unique palaeoenvironmental signature, reflecting shifting ecological balances over time .The changes in other variables during each 'dry phase' are considered to reflect the palaeoecological situation within each pollen catchment at that particular point in time. The data shown in tables 33 and 34 reveal the interaction of a range of different sources of influence and change and clearly show that changes in a single variable do not produce uniform or predictable responses in other variables.

It is suggested that, although fluctuations in climatic conditions may have been having an influence on the availability of water within the study area, the impact and response to these fluctuations was unique to the individual sites, and factors such as underlying geology, soil type, catchment drainage and vegetation cover were creating individual responses at each site which altered over time in an unpredictable manner.

It is proposed that any climate signal might be expected to be visible to a greater or lesser degree across the study area. Tables 33 and 34 clearly show that synchronous dry phases, possibly indicating a decline in precipitation, occur at approximately 7000 BP, 7200 BP, 7400 BP and 8000 BP at both Pitbladdo and Cruvie, leading to the suggestion that these events might reflect a general drying of the climate across the area. All of these phases occur within the traditionally warm and dry Boreal period. It is suggested that the other site-specific 'dry phases' recorded may be reflecting more subtle changes in the climate regime, possibly on the scale of a series of dry summers producing a cumulative impact, or the influence of anthropogenic activity on a local scale.

8:1:4 - Phases of increased fire events.

It has been suggested by Clark (1988 p.233) that "the two fundamental processes affecting fire frequency are fuels and weather". An examination of tables 31 and 32 and figure 73 shows that the frequency of fire events appears to be highest at both Methvern and Pitbladdo during the

Table 33 Phases of declining water levels and changes in other variables at Pitbladdo.

Decrease in water levels		Pollen Preservation	Pollen Concentration	pH	Mineral matter	Magnetic Susceptibility	Percentage changes in						Percentage changes in trees					Percentage changes in selected taxa				
Depth cm	Years BP						Trees	Shrubs	Herbs	Cryptogams	Indeterminates	Charcoal fragments	*Pinus*	*Betula*	*Alnus*	*Quercus*	*Ulmus*	Coryloid	*Salix*	Gramineae	Cyperaceae	Filicales
1) 268	4890	▼	~	▼	~	x	▼	▲	▼	▲	▼	▼	▲	▼	▲	▼	▼	▲	~	▼	▼	▲
2) 276	4930	▼	▼	▼	▲	x	~	~	▼	▼	▲	~	▼	▼	▲	▼	▲	▲	~	▼	▼	▼
3) 284	4980	▲	▲	▼	▲	x	▼	▼	▲	▲	▲	▼	▲	▼	▼	▲	▲	▼	▲	▲	▼	▲
4) 310	5120	~	▲	▼	~	x	▼	▼	▲	~	▼	▼	~	▼	▲	▼	▲	▼	▼	▲	▲	▲
5) 326	5210	▲	▲	▼	~	x	~	▼	▲	▼	▲	▼	▼	~	▲	▼	~	▼	▼	▲	▲	▲
6) 334	5280	▲	▲	▼	▼	x	▼	▼	▼	▲	▲	▼	▼	▲	▲	▼	▼	▼	~	▼	▲	▼
7) 348	5530	▼	▼	▲	~	x	▲	▲	▲	▼	▼	▲	~	▼	▼	▲	▲	▲	▲	▲	▲	▲
8) 378	6110	▲	▲	▲	~	x	▼	▲	~	~	~	~	▼	▼	▲	▼	▼	▲	~	~	▼	~
9) 402	6620	▲	▲	▼	~	x	▲	▼	~	▼	▲	▼	▲	~	~	▲	▼	▼	▲	~	▼	▼
10) 410	6790	▲	▲	▲	~	x	▲	▼	▼	▼	▲	~	▼	▼	▲	▼	▼	▼	▲	▼	▼	▲
11) 416	6910	▼	▼	▲	~	x	▼	▼	▲	▲	~	~	▲	▼	▼	▼	▲	▼	▼	▲	▲	▲
12) 420	C 7000	▼	▼	▲	~	x	▲	▼	▼	▲	▼	▲	▲	~	▼	▲	▲	▼	~	~	~	~
13a) 428	7180	▼	▼	▲	▲	x	▲	▼	▲	▲	▼	▲	▲	▼	▼	▲	▲	▼	▲	▲	▲	▼
13b) 430	C 7210	▲	▲	▲	▼	x	▼	▲	▼	▼	▲	~	▼	▲	▲	▲	▼	▲	▼	▼	▼	▼
14) 434	7270	▼	▼	▼	▼	x	~	~	▲	▼	▲	▼	▼	▲	▲	▲	▼	~	~	▼	~	▼
15a) 440	7370	▲	▲	▼	~	x	▼	▲	▲	~	▲	▼	▲	▼	x	▲	▼	▲	~	▼	▲	▼
15b) 444	C 7430	~	▼	▼	~	x	▲	▲	▼	▼	▼	▲	▼	▲	x	~	▼	▲	~	▲	▼	▼
16) 456	7620	~	▲	▲	▼	x	▼	▲	▲	~	▼	▲	~	▼	x	▲	▲	▲	▲	~	▲	▼
17) 480	C 8000	▲	~	▲	▼	x	▼	▲	▼	▲	▲	▼	▼	▲	x	x	x	▲	▲	▼	▼	▲

Table 34 Phases of declining water levels and changes in other variables at Cruvie.

Decrease in water levels		Pollen Preservation	Pollen Concentration	pH	Mineral matter	Magnetic Susceptibility	Percentage changes in						Percentage changes in trees					Percentage selected taxa				
Depth cm	Years BP						Trees	Shrubs	Herbs	Cryptogams	Indeterminates	Charcoal fragments	*Pinus*	*Betula*	*Alnus*	*Quercus*	*Ulmus*	Coryloid	*Salix*	Gramineae	Cyperaceae	Filicales
1) 40	4380	▲	▲	▲	~	x	▼	▲	▲	~	▼	~	~	▼	▲	▼	▼	▲	x	▲	▲	▼
2a) 248	C 7010	▲	▼	▼	▲	x	▲	~	▼	~	~	▲	▲	▼	▲	▲	▼	▼	~	▼	▲	▼
2b) 264	C 7220	▼	▼	▲	▼	x	▲	▼	▲	▲	▲	~	~	▼	x	x	▲	▼	~	▲	▲	▲
2c) 280	C 7420	▲	▲	▲	▲	x	▲	▼	▲	~	▼	~	▼	▼	x	▼	▲	▼	▼	▲	▲	▲
3) 328	C 8060	▼	▲	~	▼	x	▲	▼	~	▲	▲	▼	▲	▼	x	x	x	▼	▲	~	▼	▲
4a) 360	8480	▼	▲	▼	▼	x	▼	▲	▼	~	▼	▼	▼	▲	x	x	x	▲	▲	▼	▼	▲
4b) 376	8620	▲	▼	~	▼	x	▼	▲	▲	▼	▲	~	▲	▲	x	x	x	▲	▼	▲	▲	▼
4c) 392	8780	▲	▼	▼	▲	x	▲	▲	▼	▼	▲	~	▼	▼	x	x	x	▲	▲	▼	▼	▼
5) 440	9250	▲	~	▼	▲	x	▼	▼	▲	▲	x	▼	~	x	x	x	x	x	x	▼	▲	▲

▲ = Increase from previous level.
▼ = Decrease from previous level.
~ = No change from previous level.
x = No data available.
c = Correlation between sites.
a,b,c = Dry phases recorded at consecutive sampling horizons.

traditionally warm and dry Sub-Boreal period, and that several fire events appear to have occurred concurrently at both sites. Clark (1988 p.233) noted that

" fire cycles appear to be driven by climate and the dynamics of fuel regimes, consisting of short-term, less intense fires superimposed on less frequent intense burns."

Whilst is recognised that these apparent cross-site correlations may be purely coincidental, it is possible that these events represent large-scale fires that spanned the study area. Chandler *et al.* (1983) argued that severe fires only occur during periods of extreme drought, and Clark (1988) noted that fire cycles clearly correspond to drought cycles.

Although it is not possible to determine with certainty the exact cause of these events, the increased frequency and extent of fire events during this period is considered significant as "under certain conditions, fires are climate-controlled because certain weather conditions initiate lightning" (Tolonen 1986 p.485). It is suggested that the increased incidence of major fire events between ca. 4050 - 5220 BP, might in part at least be reflecting an increase in natural fire events during a period of generally drier climatic conditions. However, it is recognised that human activity is generally considered to have become more intensive during this period, and it is possible that humans were at least partially responsible for the charcoal peaks recorded during this period.

Assessing the probability of natural fires in the palaeoenvironmental record is hampered by the range of return dates proposed for natural fire events. The absence of data from modern woodlands, comparable to those existing in this area during the prehistoric period, makes it difficult to assess the probability of lightning-induced fires and likely return periods. Chandler *et al.* (1983) suggested that natural lightning set fires would average approximately 0.97 hectares and have an estimated natural return period of over 6000 years in European temperate forests. Whilst work in North America in a mixed conifer / deciduous woodland indicate that

"fuel continuity and ability to support a fire increase in a logistic fashion and, depending on the region, achieve some maximum level 150 to 300 years following the last fire" Clark (1988 p.234).

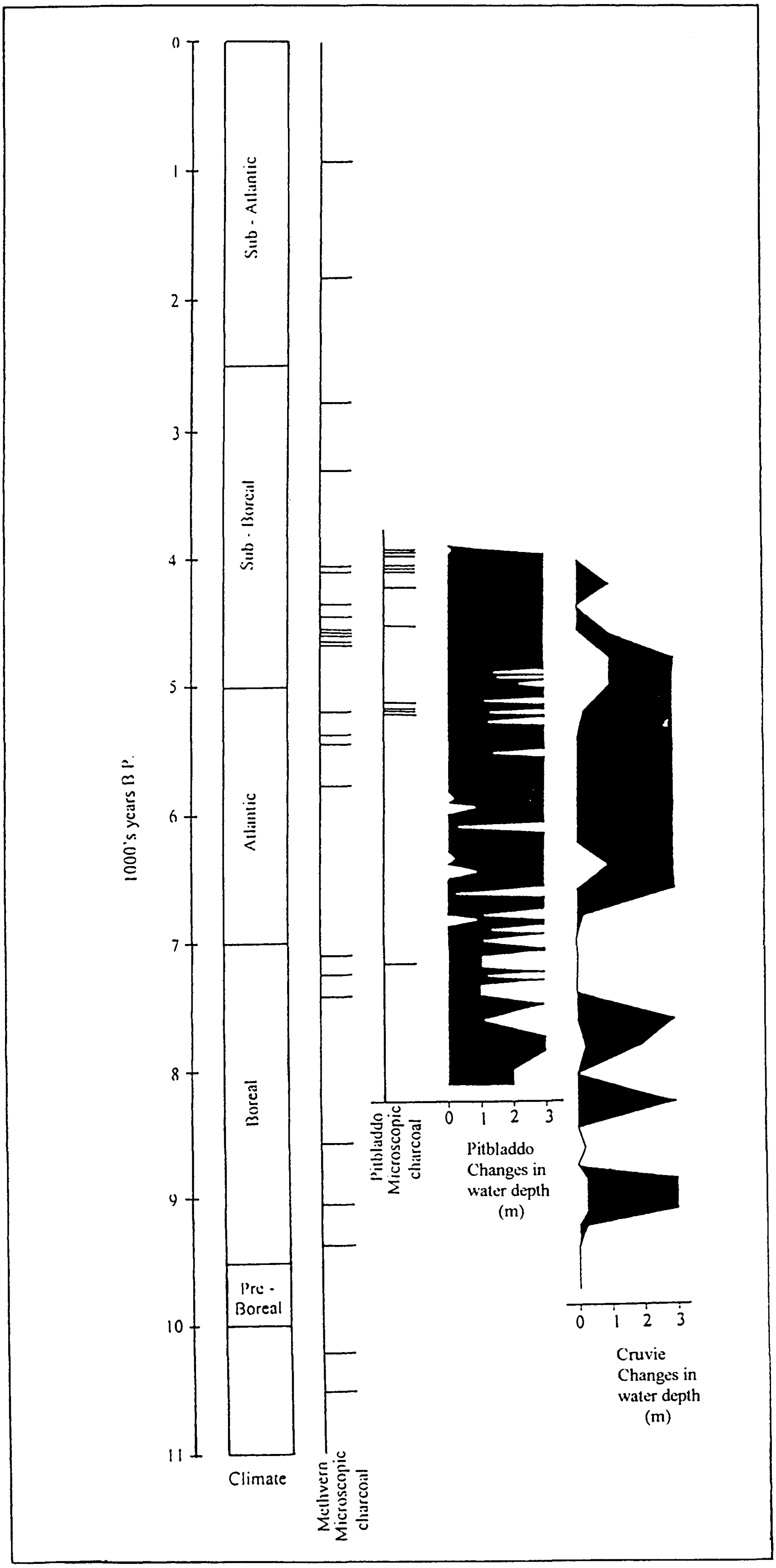
It is suggested that in the period between ca. 4050 - 5220 BP the return period between peaks in microscopic charcoal is higher than might be expected to occur naturally in a temperate woodland, although on the basis of the available evidence it is not possible to assess the accuracy of this proposal.

8:1:5 - Inter - site correlation.

Figure 73 combines the information relating to changes in water depth and microscopic charcoal, across the study area. Plotting the information from the three sites on a standard time-scale, irrespective of differing sampling intervals, allows comparisons to be made between the different parameters and the traditional sequence of Holocene climatic episodes.

One clear intersite correlation was identified using these parameters. A decline in water levels at Pitbladdo and Cruvie and an increase in the representation of microscopic charcoal at Methvern appear to have occurred concurrently at ca. 7430 BP. It is proposed that this pattern may

Figure 73 The relationship between fire events and changes in water depth within the study area



reflect a phase of drier climatic conditions across the study area, resulting in a fall in the water-table and a corresponding increase in the frequency or size of fire events.

It is clear from figure 73 that patterns of climate change are being reflected in the palaeoenvironmental record, although the response of each site is intrinsically governed by its own unique physical characteristics. Several authors (see above) have suggested the occurrence of dry phases at approximately 9000 BP and 8000 BP. Within the study area a dry phase appears to have occurred at Cruvie between ca. 9250 and 9750 BP, whilst three charcoal peaks were recorded at Methvern between ca. 9050 and 9670 BP. It is tentatively suggested that these features may indicate a period of predominantly dry climatic conditions in the period immediately following deglaciation.

In relation to the second proposed dry phase after 8000 BP it is clear from figure 73 that water-levels fluctuated considerably at both Pitbladdo and Cruvie between ca. 7000 and 8000 BP, with a number of drier episodes recorded. Overall the incidence of major fire events appears to have been low during this period; but increases in microscopic charcoal values do appear to correspond to the 'dry phases' indicated by the representation of pollen from aquatic taxa, suggesting a possible correlation. It is suggested that the various trends recorded between ca. 7000 and 8000 BP may reflect a series of climatic fluctuations, whose occurrence has also been identified in the palaeoenvironmental record by other researchers at a range of sites.

Between ca. 4380 and 7010 BP water levels appear to have remained consistently high at Cruvie, whilst the dry phases recorded at Pitbladdo appear to have been less frequent than those recorded during the Boreal period. No significant fire events were recorded between ca. 5770 and 7100 BP at Methvern and ca. 5220 to 7180 BP at Pitbladdo. Overall these changes appear to suggest an increase in precipitation during this period, resulting in high water tables and decreasing the incidence of natural fires. However, the occurrence of a number of drier phases at Pitbladdo during this period suggests that either conditions were not exclusively wet, or that other factors, such as sediment inwash, were instigating a drop in water-levels at this site.

The series of fire events and corresponding falls in water-levels recorded at Pitbladdo between ca. 5120 to 5220 BP, but not recorded at Cruvie, suggests a change that was focused upon the area of Pitbladdo. It is of note that the first fire event of the series at Pitbladdo was matched by a fire event at Methvern. It is possible that this is purely coincidental, but it may reflect the occurrence of a large fire crossing the study area at approximately 5220 BP. On the basis of the available evidence it is not possible to determine the cause of this event.

At both Methvern and Pitbladdo the number of fire events appears to increase during the traditionally warm and dry Sub-Boreal. The small closed catchment at Cruvie records an overall fall in water levels during this period. However, no decline in water-levels occurred at Pitbladdo during this period, and on the basis of the available evidence it is not possible to determine if the increase in fire events is reflecting climatic controls or other factors such as anthropogenic activity.

Methvern is the only site that contained sediments relating to the later Sub-Boreal and Sub-Atlantic periods. The charcoal record from this site indicates a significant decline in the frequency of fire events from ca. 4060 BP, with only two major fire events occurring within the Sub-Atlantic period. It is suggested that this might reflect wetter or colder conditions during this period, resulting in a decrease in natural fires. Alternatively, this decrease might relate to a decline in the use of fire by the local human populations, or possibly the absence of major fires in a landscape containing significantly fewer trees.

It is proposed that the available data appear to suggest that a degree of climate instability existed throughout the Holocene. However, the identification of the climate signal, from the palaeoenvironmental record, amongst the 'noise' created by other instigators of vegetation modification is not simple and the arguments outlined above remain open to further revision.

8:2 - Early Holocene woodland development.

8:2:1 - Introduction.

Arboreal taxa are the dominant floristic group within the Holocene palaeoenvironmental record. The establishment, consolidation and decline of woodland as the dominant vegetation type, across the majority of the British Isles, represents one of the key areas of interest to many palaeoecologists.

Throughout the following discussion a number of terms (after Bennett 1986a) are used to describe patterns of vegetation development as inferred from the pollen diagrams. 'Appearance' is defined as the intermittent occurrence of pollen grains of a particular taxon in the pollen record, but is not considered to indicate the presence of a local population of the taxon. 'Arrival' is defined as the first local presence of a taxon, and is recognised by the continuous presence, at low percentage values, of the pollen morphotype in the pollen record. 'Rise/expansion' is defined as an increase in the local population of a taxon, and is recognised by consecutive percentage increases in the representation of the taxon in the pollen record. 'Spread/range expansion' is defined as the movement of a taxon into and/or within a geographical area, and is recognised by variations in timing of the arrival and expansion of a given taxon in the pollen records from different locations within the study area.

The arrival of arboreal taxa in Scotland at the beginning of the Holocene may be related to the amelioration in climate that occurred following deglaciation, whilst the time-lag that existed between this improvement in conditions and the subsequent arrival of the different arboreal taxa may be linked to

"inherent differences in the rate and direction of spread of the trees across mainland Europe from their locations at the beginning of the Holocene" (Iversen, 1960).

The directions of expansion that each taxon took across Britain following its arrival is considered to have been "primarily controlled by the location of first arrival, and secondarily by topography and climate" (Birks 1989 p.526). This resulted in a complex pattern of expansion, governed by environmental and biotic constraints, including edaphic and climate requirements, rates of dispersal, propagation methods and competitive interaction with established taxa (Bennett 1986). One of the key factors influencing rates of expansion is the ability of the invading taxon to establish themselves upon arrival. In order to expand into an area it is recognised that a taxon must

"not only disperse its propagules but also become established, invade, and expand into vegetation beyond its range limits" (Birks, 1989 p.522).

The way in which a taxon gains a foot-hold and expands into a new area may be determined not only by environmental and biotic constraints but also by chance and opportunity. Carter and Prince (1981) argued that disturbed areas represent sites susceptible to invasion and provide the opportunity for colonisation, and that the timing and frequency of such disturbances are determined by chance. Established vegetation presents a barrier to invasion and the ability of an incoming taxon to compete with the established vegetation in the exploitation of gaps, created during periods of disturbance, such as fire, disease, windthrow, natural deaths or human activity, may significantly influence its rate of spread (Smith 1965). Critical to expansion is the establishment of seedlings, whose success is determined by local climate and soils, the levels of predation and parasitism, and their ability to compete with other taxa (Harper 1965). It is the interaction of all of these factors that creates the complex patterns of migration and development recorded in the palaeoenvironmental record.

In recent years the production of pollen isochrone maps for the British Isles outlining the general patterns of tree spreading (Birks 1989) and dominant woodland cover across Scotland during specific periods (Birks *et al.* 1975, Bennett 1989, Tipping 1994) has established a general picture of woodland development across Scotland and highlighted the areas in which particular arboreal taxa dominated during the mid-Holocene period. Although these maps have provided a useful guide to broad trends, the limited number of sites and the often considerable distance between them, has resulted in diagrams that lack spatial resolution and underplay the degree and importance of local patterns of development.

Overall the main arboreal taxa show a similar sequence of migration throughout Scotland (Birks 1989, Tipping 1994). *Betula* was the first arrival in the period immediately following the end of the Loch Lomond Stadial, and was established in eastern and central areas by ca. 10000 BP (Vasari 1977, Whittington *et al.* 1990). *Corylus* was the next arrival and appears to have been established in eastern and lowland areas by about 9300 BP (Lowe 1978, Whittington *et al.* 1991). *Corylus* was followed by *Ulmus* and *Quercus*, which reached eastern Scotland by about 8500 BP and 8000 BP respectively (Birks 1989).The appearance of the last of the main arboreal taxa, *Alnus,* was until fairly recently considered to be a synchronous event across the entire country. However, radiocarbon dating of this event at a range of sites suggests that the *Alnus* rise is not synchronous, but shows a considerable degree of local diversity (Chambers and Elliot 1989, Bennett and Birks 1990, Tallantire 1992). Available data indicate that *Alnus* expanded through eastern Scotland between 7000 and 6000 BP (Birks 1989), with slightly earlier dates (e.g. 7400 BP, Whittington *et al.* 1991) recorded in coastal areas.

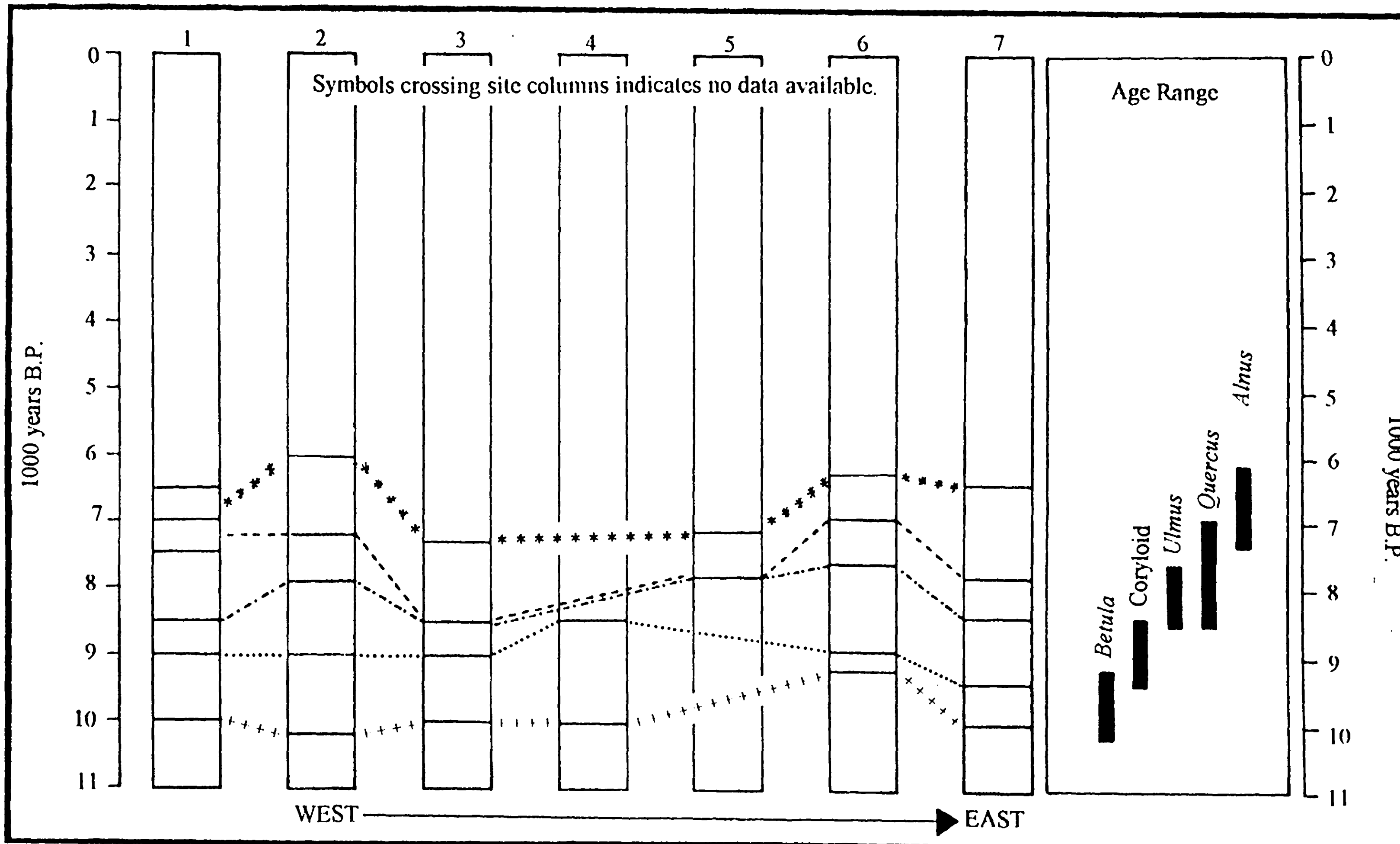
The investigation of three sites within a limited geographical area presented the opportunity to investigate the extent of variation that can exist in woodland development across a relatively limited area. Section 8:2:2 considers the sequence and patterns of colonisation as they occur across the study area and suggests local factors that could have influenced these patterns.

8:2:2 - The study area.

This section focuses upon the three sites investigated during this study. Reference is also made to findings from other dated and published palaeoenvironmental investigations within the study area: Black Loch (Whittington *et al.* 1990), Creich Castle (Cundill and Whittington 1983) and Pickletillem (Whittington *et al.* 1991).

Figure 74 clearly shows the temporal variations that exist in the establishment of different arboreal taxa across this small area. At each of the sites the sequence of migration follows that

Figure 74 The expansion of arboreal taxa.



KEY

-.-.- *Ulmus*	.... Coryloid
---- *Quercus*	* * * *Alnus*
	+ + + + *Betula*

1 = Predicted isochrone for eastern lowland Scotland (Birks 1989).
2 = Methvern.
3 = Black Loch (Whittington et al 1990).
4 = Creich Castle (Cundill and Whittington 1983).
5 = Pitbladdo.
6 = Cruvie.
7 = Pickletillem (Whittington et al 1991).

recorded elsewhere in eastern, lowland Scotland (Birks 1989). However, a comparison of the different sites (figure 74) shows that significant differences exist in the timing of the events in this sequence within this 41 km area. Table 35 indicates that the sequence of arrival within the area can not be consistently predicted on the basis of previous taxa and that the individual taxa take a variable amount of time to expand across the area.

It is recognised that since each of the dates used in figure 74 and table 35 incorporates a degree of error, the results must be interpreted with a considerable degree of caution. However, even allowing for this inherent difficulty, the data presented indicate a complex pattern of development.

Table 35 showing the order of arrival of the main arboreal taxa to sites in the study area.

Taxa in order of arrival	Order of arrival in study area. Earliest ----- latest. / = concurrently	Duration of spread 1st to last arrival
Betula	Methvern ---- Black Loch / Creich Castle / Pickletillem ---- Cruvie	1440 years
Corylus	Pickletillem ---- Methvern / Black Loch ---- Cruvie ---- Creich Castle	900 years
Ulmus	Black Loch ---- Pickletillem ---- Methvern ---- Pitbladdo ---- Cruvie	870 years
Quercus	Black Loch ---- Pitbladdo / Pickletillem ---- Methvern ---- Cruvie	1490 years
Alnus	Black Loch ---- Pitbladdo ---- Pickletillem ---- Cruvie ---- Methvern	1190 years

Table 36 showing the expansion of arboreal taxa at the sites investigated during this study.

Taxa	**Methvern**	**Pitbladdo**	**Cruvie**
Betula	620	x	310
Coryloid	160	x	450
Ulmus	330	380	820
Quercus	780	440	1200
Alnus	120	310	820

Dates are expressed in uncalibrated years BP and due to differences in sampling provide only a guide to rates of expansion and must be viewed with a considerable degree of caution. Expansion is defined as the period from the first occurrence of the taxon at > 1% TLP to its 1st peak, based on consecutive % increases.

It is suggested that the patterns shown in figure 74 and tables 35 and 36 reflect the influence of local topographical, geological, edaphic and biotic factors on the expansion of individual arboreal taxa, including factors such as soil type (influenced by the underlying geology), catchment hydrology, the altitude of the site, slope gradients and aspect and competition. It is recognised that other factors such as climatic regime and altitude might also have had a considerable influence. However, as all of the sites considered are located in lowland areas at approximately similar altitudes and within 41 kilometres of each other, the possibility of significant differences based upon these two factors is considered to be minimal.

The following section considers these patterns in relation to the physical characteristics of the three sites investigated during this study, and speculates on the extent to which other factors such as climate and anthropogenic activity affected the patterns of arrival and expansion.

The physical location, underlying geology and soil series relating to the sites under investigation are detailed in Chapter One. Table 37, shown below, summarises the main physical characteristics of the areas surrounding each site.

Table 37 Summary of the physical characteristics of the sites under investigation.

Site	Cruvie	Pitbladdo	Methvern
Altitude	48 m OD	67 m OD	40 m OD
Location	Closed basin	Valley floor	Valley floor
Hydrology	Catchment runoff and precipitation no natural outflow	Catchment runoff and precipitation no natural outflow	Precipitation no natural outflow
Area	88 m by 50 m	1125 m by 200 m	1375 m by 425 m
Slope gradients	Moderate slopes used for modern arable cultivation	Gentle and moderate used for modern arable cultivation	Gentle slopes used for modern arable cultivation
Solid geology	andesite and basalt	andesite and basalt	cross-bedded sandstones
Drift geology	peat alluvium till glacial meltwater exposed bedrock	peat alluvium till exposed bedrock	peat alluvium till glacial meltwater raised marine
Soil groups	brown forest alluvial non-calcareous gleys	brown forest alluvial non-calcareous gleys	brown forest alluvial non-calcareous gleys

The distribution and representation of the geological and soil groups varies considerably between the three sites (see Chapter one). In addition to these broad divisions, the distribution of individual soil series indicate small-scale localised occurrences of a range of soil conditions (Chapter one figures 15 to 20). This results from "the integrated effects of climate, parent rock, vegetation, relief of the land and time" (Packham and Harding 1982 p.56) and represent a single point in a process of ongoing change.

As these patterns represent the product of past processes, they provide the best available guide to possible past soil distributions. It is suggested that local edaphic conditions may have had a significant impact upon patterns of woodland development within the study area during the early Holocene. It is considered that, on the basis of the available data it is not possible to determine the processes that were taking place during the establishment of early Holocene woodlands, as "we do not know how the taxa composition of a woodland is controlled" (Bennett, 1986 p.617) and edaphic conditions are just one of the main constraints influencing development. However, a number of speculative observations may be made in relation to the distribution and expansion of the main arboreal taxa.

The arrival of *Betula* at all of the sites within the study area may be related to its role as a pioneer coloniser of immature soils (Dimbleby 1952). At five of the six sites considered the arrival of *Betula* falls within the 10 000 BP isochrone proposed by Birks (1989), suggesting a degree of conformity, which indicates "a virtual absence of stresses, climatic, edaphic or competitive" (Tipping 1994 p.10).

The comparatively late arrival of *Betula* (9250 +/- 80 BP) at Cruvie, may be related to continued surface instability and the late development of soils at this site during the early Holocene. The site at Cruvie is underlain by an area of andesite and basalt, similar to that recorded at Pitbladdo, and is morphologically similar to Pickletillem, the kettle hole site investigated by Whittington *et al.* (1991). However, dates for the arrival of *Betula* at Pitbladdo and Pickletillem suggest that soil development was not delayed at either of these sites. The only apparent difference between Cruvie and other local sites, is the presence of a substantial area of bedrock at or near the surface close to the site. It is suggested that the slow development of soils across these areas may have delayed the establishment of *Betula* in the local area. The likelihood that the date recorded was a product of a dating problem was considered in Chapter five, and the possibility of sampling and hard-water errors largely discounted. It is considered that the late arrival of *Betula* at Cruvie may be linked to local environmental factors, but on the basis of available data the clear identification of these factors is not considered possible.

Following arrival, *Betula's* rate of expansion appears to have been slower at Methvern, and its initial peak of 27 % TLP considerably lower than the 50 % TLP attained at Cruvie. It is proposed that once an initial foot-hold was established, conditions for *Betula* expansion were more favourable at Cruvie than Methvern, allowing fast and extensive colonisation of the Cruvie catchment. The maximum of 38 % TLP recorded at Pitbladdo indicates conditions between the other two sites. On the basis of available data the factors that determined these trends remain unclear. However; it is tentatively suggested that as *Betula* establishes itself best on bare soil (Grime *et al.* 1989), it may have been most abundant in those areas of late developing soils associated with exposed bed rock, a trend that would have resulted in greater abundance of *Betula* at Cruvie and Pitbladdo than at Methvern.

Referral to figure 74, showing all published sites, suggests a slight west-to-east pattern of arrival within the study area, with the exception of the most easterly site, Pickletillem (Whittington *et al.* 1991). However, the application of a two sigma error to the dates recorded at each site suggests that the arrival of *Betula* at five of the six sites, the exception being Cruvie, was nearly synchronous on the basis of radiocarbon dates.

Corylus was the next taxon to arrive at all sites, rapidly replacing *Betula* as the dominant taxon. The rapid expansion and relative abundance of *Corylus*, recorded in pollen diagrams across mainland Britain during the early Holocene, is an issue that has instigated a considerable amount of debate amongst palaeoecologists. The arrival of *Corylus* before *Quercus* and *Ulmus* during the Holocene, contrasts to that recorded in previous interglacials (West 1980).

Several hypotheses have been presented to explain this change. These include the suggestion that humans may have inadvertently or deliberately introduced *Corylus* to new areas (Boyd and Dickson 1986), or that fire may have played a significant role in the expansion of *Corylus* during the early Holocene, either humanly instigated (Smith 1970) or natural fires during periods of drier climatic conditions (Huntley 1993). The assertion that "there is no doubt that the European *Corylus avellana* is fire resistant" (Smith 1970 p.83)

led to the suggestion that *Corylus* was able to quickly colonise areas cleared by fires, and that frequent fires would have helped to maintain open canopy conditions, allowing *Corylus* to remain a dominant taxon beyond the period associated with seral succession (Huntley 1993). However, the extent to which European hazel is able to tolerate and therefore benefit from fire events has been questioned (Rackham 1980). In addition it has been suggested that *Corylus*

"simply happened to be the first shade tolerant tree to immigrate; at the onset it met no serious competition" (Iversen 1960, p. 9).

Within the study area *Corylus* appears to have arrived first at Pickletillem (9350 +/- 70 BP - Whittington *et al.* 1991), followed by Black Loch (Whittington *et al.* 1990) and Methvern at ca. 9000 BP, Cruvie at ca. 8910 BP and finally Creich Castle at 8449 +/- 85 BP (Whittington *et al.* 1991). The order of arrival suggests no discernible direction of expansion across the area, figure 74, but *Corylus* does appear to have established a presence more quickly than *Betula* (table 35). A consideration of the three sites under investigation indicates that *Corylus* expanded faster at Methvern than at Cruvie, but that its initial peak of 58 % TLP was considerably lower than the 75 % TLP recorded at Cruvie. The slowest rate of expansion was recorded at Pitbladdo which also recorded the lowest maximum value (41 % TLP). It is suggested that conditions were most favourable to expansion at Methvern, but a greater degree of dominance was attained at Cruvie, whilst conditions at Pitbladdo were less suitable, slowing expansion and preventing *Corylus* from attaining dominance. It is considered that the identification of the causal factors relating to these patterns is not possible on the basis of the available data. However, the recording of microscopic charcoal at the sites under investigation does permit a consideration of the evidence relating to the expansion of *Corylus* and the incidence of fire.

At Cruvie there is a very clear *Corylus* rise and peak but this does not correspond to changes in the microscopic charcoal record (see figure 75).The representation of microscopic charcoal at this site is extremely low through the majority of the core. However, even on the basis of the limited amounts of charcoal present, it is clear that charcoal levels decline during the *Corylus* expansion and reach their lowest levels at the *Corylus* maximum. The site at Methvern also has a *Corylus* curve that shows a clear rise and maximum. At Methvern the representation of charcoal is comparatively high during the period during which *Corylus* is expanding (figure 76) and the fastest expansion of *Corylus* did occur at Methvern. During the period of the *Corylus* maxima the representation of charcoal shows a sharp decrease, and the possible association between the dominance of *Corylus* and the maintenance of an open canopy by fire is not apparent at this site. At Pitbladdo it is not possible to identify any clear relationship between the *Corylus* and charcoal curves, although a slight dip in the representation of charcoal was recorded at the *Corylus* maximum (see figure 77). Overall there is no indication that there was increase in fire activity corresponding to the *Corylus* rise or maximum. Generally the level of microscopic charcoal recorded during this period was consistently higher at

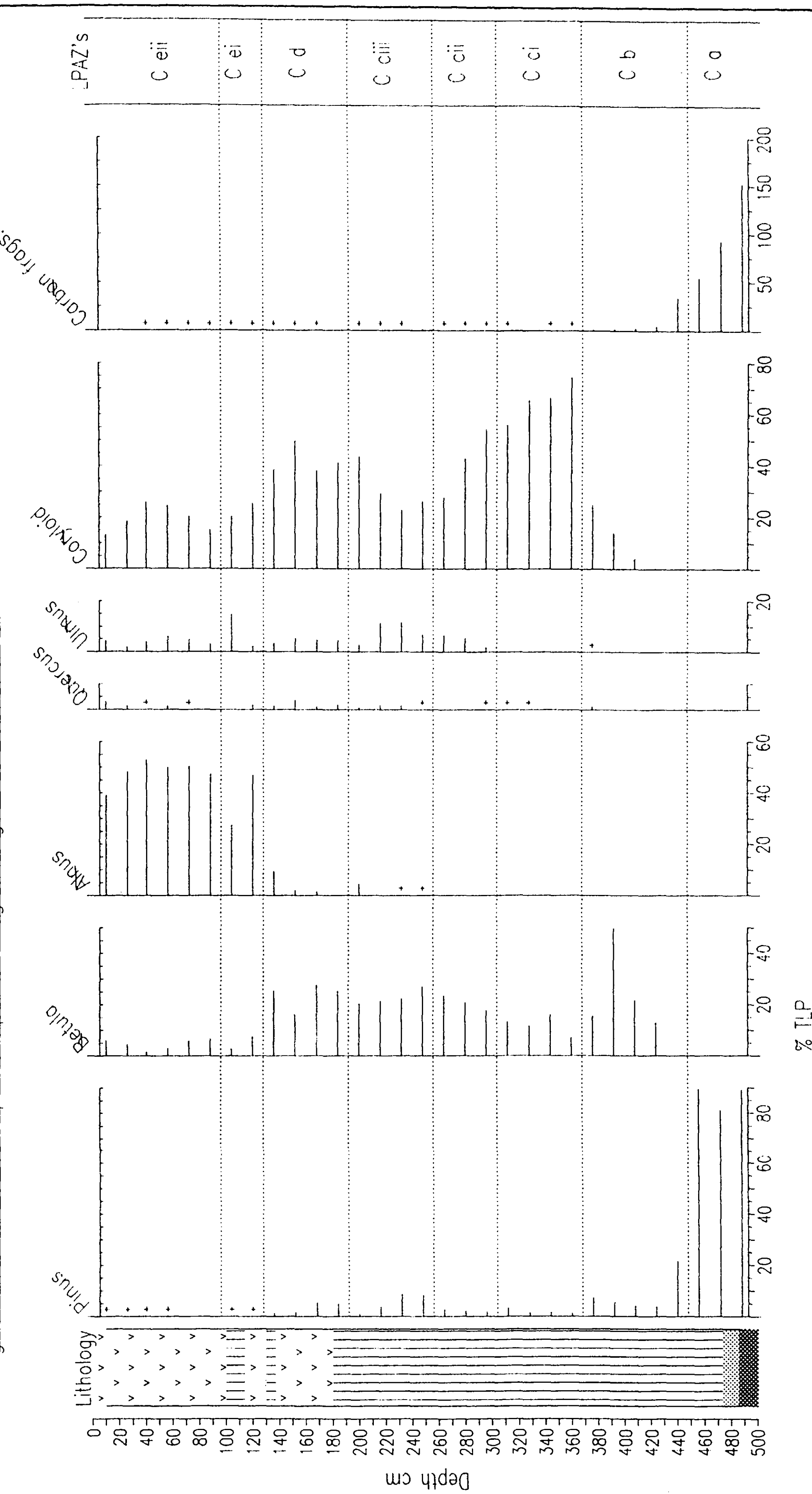


Figure 75 Selected pollen percentage diagram for Cruvie.

Figure 76 Pollen percentage diagram for Methvern.

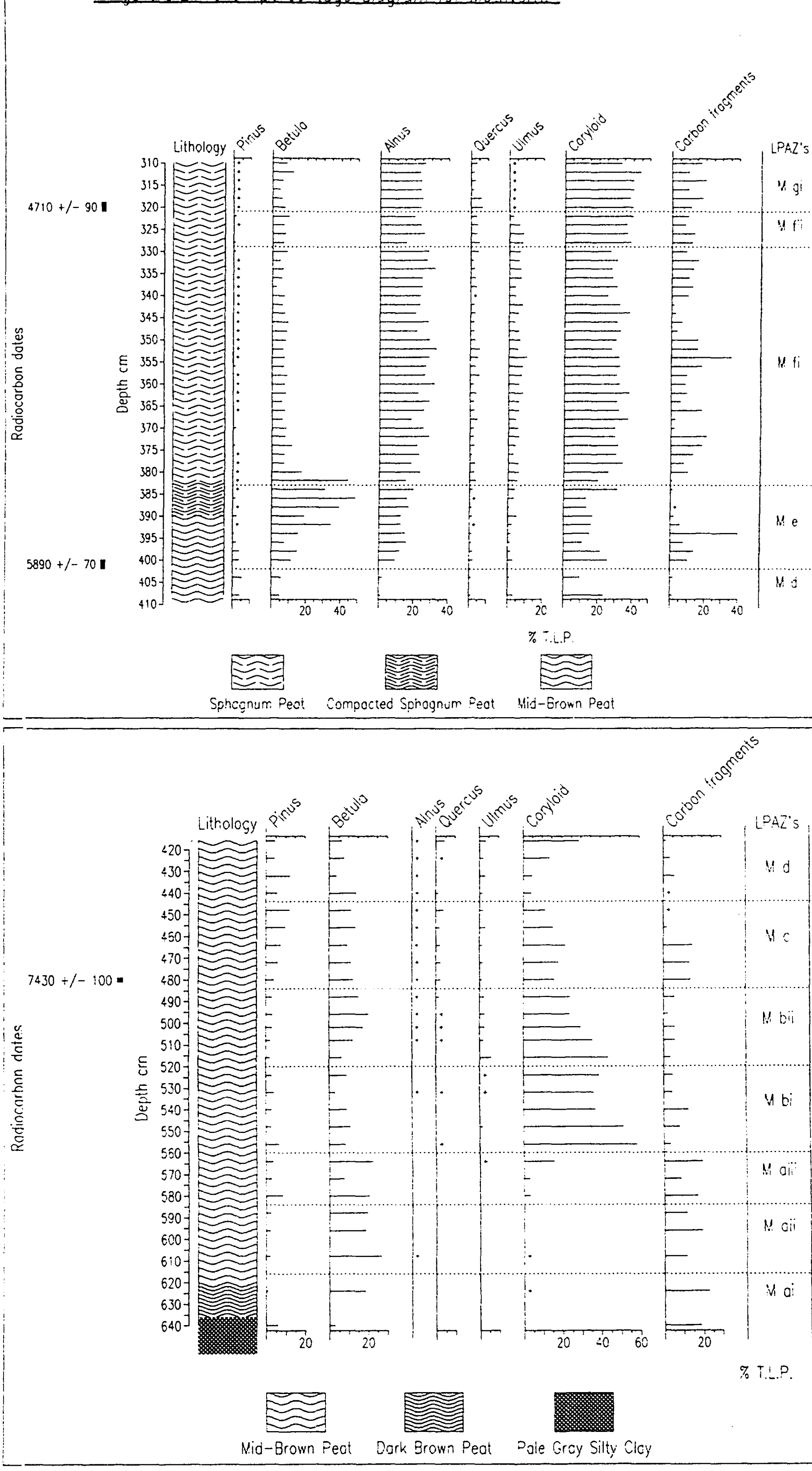
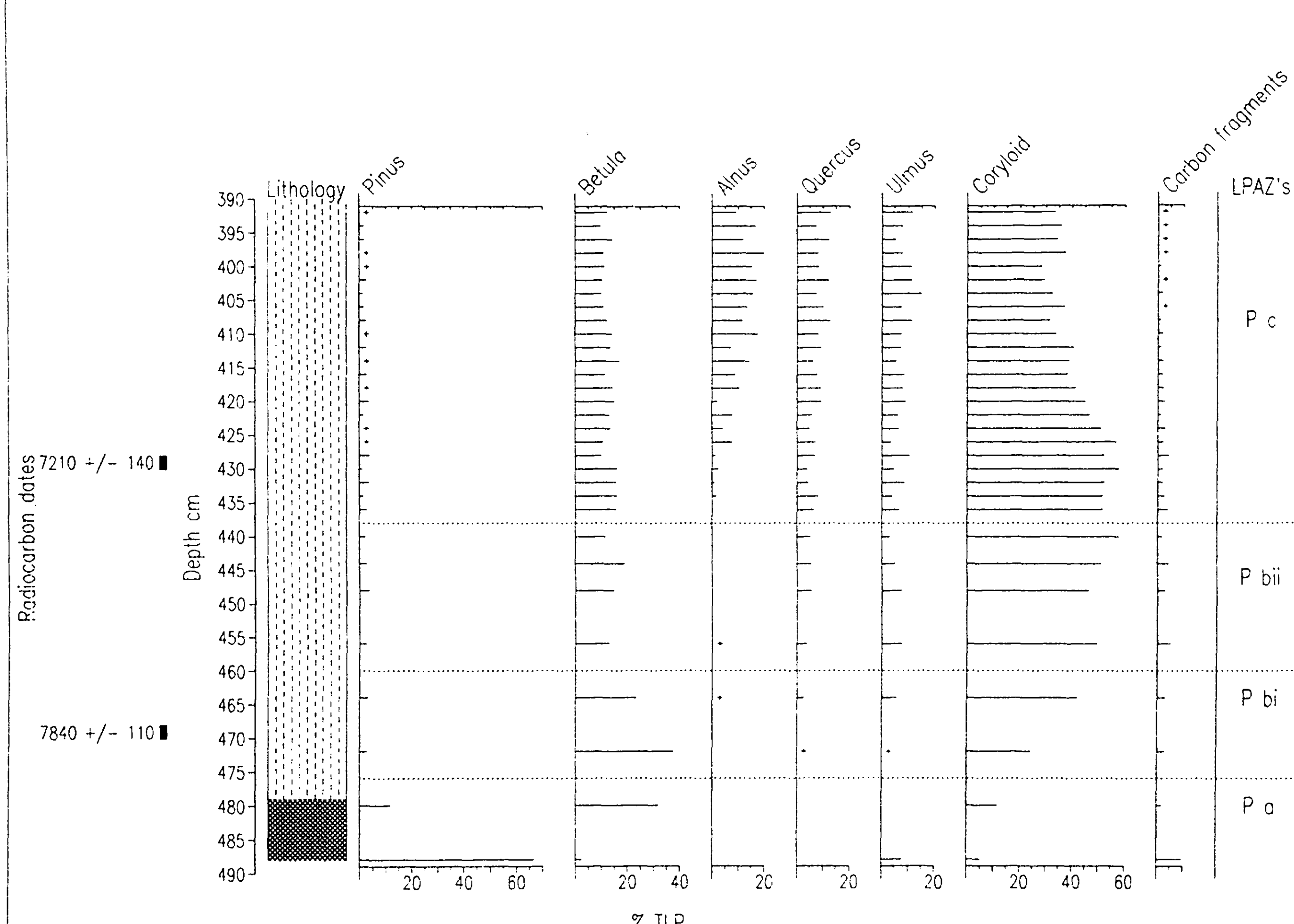


Figure 77 Pollen percentage diagram for Pitbladdo.



Methvern than at Cruvie, but at both sites there was no clear positive association between the representation of charcoal and the early expansion, abundance and dominance of *Corylus*.

It is proposed that although there is evidence suggesting a period of arid climatic conditions at approximately 9000 BP (Digerfeldt 1988, Lowe 1993) the lack of firm evidence relating to increased fire frequency during the *Corylus* expansion, limits the establishment of a link between *Corylus*, natural fires and/or anthropogenic use of fire. The absence of a positive correlation between the establishment of *Corylus* and an increase in the representation of microscopic charcoal at these sites corresponds to findings elsewhere in Scotland (Edwards 1990, Bennett *et al.* 1990, Simmons 1993). In addition, although the recovery of hazel nuts from archaeological sites, in Scotland dating from the Mesolithic (Coles 1971, Wickham-Jones 1989), indicate that hazel nuts were utilised by the human population, ethnographic models provide no unequivocal evidence of the deliberate planting of hazel nuts by hunter-gatherer populations (Huntley 1993), and it is considered that

"the perceived relationship between the spread of hazel and the distribution of Mesolithic communities may concern the changing patterns of Mesolithic settlement mirroring the migration of this component of the temperate woodland cover". (Edwards and Ralston 1984 p.18).

The next arboreal taxon to arrive within the study area was *Ulmus*. The site order in which *Ulmus* arrived within the study area differed slightly from that of *Corylus* (see figure 74) but the rate of spread (allowing for radiocarbon dating errors) was close to that of *Corylus*. At the sites under investigation *Ulmus* arrived first at Methvern, followed closely by Pitbladdo and Cruvie, the rates of expansion mirroring those of arrival (figure 74, table 36). The initial peaks in representation reversed this order with a peak of 6 % TLP at Methvern, 8 % TLP at Pitbladdo and 12 % at Cruvie. It is suggested that these patterns suggest that *Ulmus* quickly filled its ecological niche at Methvern and Pitbladdo, but took slightly longer to fill all possible locations at Cruvie, where conditions appear to have been slightly more favourable to its expansion. The preference of *Ulmus* for well drained soils (Grime *et al.*, 1988) determined the areas in which it was best able to compete with the more adaptable *Corylus*. It is tentatively suggested that the steeper slopes in the area surrounding Cruvie may have provided more well drained areas, suited to colonisation by *Ulmus*, than the gentler slopes surrounding Pitbladdo and Methvern.

The arrival of *Quercus* within the study area showed a degree of overlap with the arrival of *Ulmus*, and at both Black Loch (Whittington *et al.* 1990) and Pitbladdo *Ulmus* and *Quercus* appear to have arrived contemporaneously at ca. 8500 BP and ca. 7870 BP respectively. It is suggested that the order of arrival across the study area was being determined by the local environmental and biotic conditions at each site. At five of the six sites *Quercus* arrived later than ca. 7800 BP and the earlier date of ca. 8500 BP, recorded at Black Loch is anomalous for the area and remains unexplained (Whittington *et al.* 1990). If the date recorded from Black Loch is excluded from table 36, the rate of spread across the study area falls to ca. 890 years, a comparable figure to that recorded for both *Ulmus* and *Corylus* (figure 74).

At the sites under investigation *Quercus* arrived first at Pitbladdo, followed by Methvern and then Cruvie, a change to the pattern of previous taxa, which arrived first at Methvern. Rates of expansion once again followed the pattern of arrival, the fastest rate occurring at Pitbladdo and the slowest at Cruvie. The representation of *Quercus* showed little variation between sites, with peaks of 6 % TLP at Pitbladdo and 4 % TLP at Methvern and Cruvie, suggesting that *Quercus* was filling a similar niche at each of the sites. As *Quercus* "occurs in a wide range of woodland types and soils and as a pioneer or seral tree"(Rackham 1980), it is suggested that *Quercus* was maintaining a small population within a predominantly *Corylus* woodland, and that the relatively low representation of both *Ulmus* and *Quercus* may reflect the dominance that *Corylus* had achieved, having formed a self-replacing woodland which the other two could not easily penetrate (Iversen, 1973). The present preference of *Quercus* for soils with a pH of below five and its ability to tolerate damp soils (Grime *et al.* 1989) suggests that *Ulmus* and *Quercus* were probably exploiting similar, but different ecological niches within the woodland mosaic.

The last of the main arboreal taxa to arrive was *Alnus*. The broad range of dates recorded within this limited geographical area, ca. 6000 BP to ca. 7300 BP, is considered to reflect the strong influence of local factors on the establishment of this taxa. The earliest date for this area, of ca. 7300 BP, was recorded at Black Loch (Whittington *et al.* 1990). At the time the study at Black Loch was undertaken this represented the only published site with an *Alnus* rise in northern Fife and it was suggested that

"the presence of coastal and estuarine habitats relatively close to Black Loch may have allowed the earlier penetration of *Alnus* into this area compared with some of the more inland locations" (Whittington *et al.* 1990).

However, the later dates of ca. 6420 BP recorded at Pickletillem (Whittington *et al.* 1991) and 6220 +/- 70 BP at Cruvie, both of which are located closer to the coast than Black Loch, suggests that other factors may have determined the early arrival of *Alnus* at this site. The site at Pitbladdo, which is closest to that of Black Loch, approximately 9.5 km to the east, also records an early date of ca. 7130 BP for the *Alnus* rise. Unfortunately on the basis of available data is not possible to determine the factor or factors that link these two sites and resulted in the early *Alnus* rises recorded.

At the three sites under investigation *Alnus* arrived first at Pitbladdo, then Cruvie and finally Methvern, although the presence of *Alnus* pollen at Methvern at less than 1 % TLP for almost 2000 years prior to its expansion, suggests either the operation of long-distance transportation, or that a small local population may have been established at this site before its establishment in any other part of the study area. The size of the site at Methvern and the central location of the core examined suggest that approximately 70 % of the pollen recovered from Methvern had a regional source and was composed of rain and canopy components (based on Jacobson and Bradshaw 1981). Therefore it is proposed that wind transportation is the most likely source for the low pollen frequencies (< 1 %) initially recorded at Methvern.

The slowest rate of expansion was recorded at Cruvie. However, this site also showed the highest peak of 47 % TLP, followed by 16 % at Methvern and 10 % at Pitbladdo. It is proposed that the apparent dominance that *Alnus* achieved at Cruvie may in part reflect the nature of its pollen catchment. Cruvie has a small pollen catchment, in which the local pollen component forms approximately 30 % of the received pollen (based on Jacobson and Bradshaw 1981). The presence of fragments of *Alnus* in the cores recovered indicate the close proximity of *Alnus* to the coring site and suggest that *Alnus* may have established an area of carr surrounding the site. The small area of poorly drained non-calcareous gleys surrounding the site, offers an ideal habitat to the competitively inferior *Alnus*. The fall recorded in the pollen concentrations of the other main arboreal taxa synchronously with the *Alnus* rise is considered to reflect, in part at least, the impact of this carr. The presence of a band of *Alnus* trees effectively acting as a pollen filter, combined with the small pollen catchment of this site, resulted in the high *Alnus* values recorded at Cruvie. It is suggested that *Alnus* may have filled a similar ecological niche at Methvern and Pitbladdo, but that their larger pollen catchments may have lessened the impact of its expansion upon the pollen record. It is possible that the freely drained soils that dominate the area surrounding Pitbladdo may have restricted the area open to colonisation by *Alnus*.

The role that other factors such as climate change and fire may have played in promoting the expansion of *Alnus* is a matter of debate. *Alnus* is an adventitious coloniser but competitively inferior to other arboreal taxa (Bennett 1986), and in order to expand may have required the ecological balance of the established woodland to be disturbed. Some researchers (McVean 1956, Smith 1984) have suggested that burning and clearance, related to human activity, could have encouraged its spread. The creation of clearings would have resulted in an increase in available light, on which seedlings of *Alnus* are dependent (Grime *et al.* 1989). Alternatively, fluctuations in climatic conditions may have had a degree of influence. Tallantire (1992) argued that the expansion of *Alnus* may have been delayed and restricted due to "the seasonal, prolonged periods of drought during the Boreal chronozone".

The *Alnus* expansion at Cruvie is a clearly defined feature (see figure 75). However, charcoal is not well represented during this period and the charcoal record shows no variations in response to the *Alnus* rise. At Pitbladdo the relationship between the *Alnus* and charcoal curves is unclear, as charcoal values fluctuate considerably during this period (figure 77). Immediately before the *Alnus* expansion a peak is recorded in the charcoal curve, but during the period of expansion charcoal values fall slightly. At Methvern the clear expansion of *Alnus* is mirrored by an increase in charcoal values (see figure 76).

Overall it is not possible to establish a clear link between the expansion of *Alnus* and fire events at these sites. The ambiguous findings at these sites mirror the findings of Edward's (1990) review of the possible links between fire and the *Alnus* rise at sites throughout Scotland. The possible influence of climatic fluctuations on the spread of *Alnus* is also difficult to determine, and although a number of fluctuations do appear to have occurred in the period prior to the expansion of *Alnus* (see section 8:1), no clear association has been made between the two lines of evidence.

Overall it is considered that the patterns of woodland development discussed above reflect the interaction of factors such as chance and opportunity in dispersal and expansion combined with the influence of local site controls, resulting in the complex patterns of development recorded in the pollen record.

8:3 - Human activity.

8:3:1 - Introduction; the nature of the evidence.

When attempting to assess the extent and nature of human activity within an area during any given time period, interpretation may be based upon the palaeoenvironmental evidence, the archaeological evidence or a combination of the two, the last-named being the most desirable approach. This section considers the extent to which human activity may be detected in the palaeoenvironmental record. Differentiating between vegetation dynamics attributable to colonisation, competition and succession and human modification of the environment is not an easy task and it is acknowledged that the utilisation of forest resources without substantial modification during the early Holocene is difficult if not impossible to detect.

The detection of human activity is based on the consideration of changes in the palaeoenvironmental record and an assessment of the significance of these changes in relation to other lines of evidence. Factors considered significant include changes in the representation of arboreal taxa, the presence or absence of a range of 'indicator species' and changes in the sedimentary record including increases in inorganic matter, increases in sedimentation and pollen influx rates and changes in pollen preservation.

Fluctuations in the representation of arboreal pollen are considered to be significant since a reduction in tree pollen as a whole, or the decline of specific taxa, may reflect the creation of clearings by humans within a naturally wooded environment, whilst an increase in arboreal pollen could reflect a period of woodland regeneration possibly indicating a decrease in the intensity of human activity. However, changes in the levels of arboreal pollen might also relate to natural processes such as windthrow, senescence and disease, or changes in pollen productivity.

Alterations in the sedimentary record considered significant in relation to human activity include increases in the representation of mineral material and deterioration in pollen preservation. It is suggested that these changes may possibly be linked to increased soil instability due to land clearance and early farming techniques. Variations in the representation of microscopic charcoal may result from the use of fire by humans either as a method of hunting / manipulating wildlife, woodland clearance or for domestic cooking purposes (Simmons 1975, Mellars 1976, Bennett *et al.* 1990). Changes in pollen influx rates may be significant in identifying limited woodland clearance within a predominantly wooded environment. Work by Aaby (1986, 1988) has suggested that initial human activity may lead to an increase in the influx of arboreal pollen and depress non-arboreal pollen input, changes that may be recorded in the pollen record at each site.

Changes recorded in the general palynological and sedimentary records of the individual sites were presented in Chapters Five to Seven. This section focuses upon changes in the representation of specific indicators, taxa that are considered particularly sensitive to human related landscape modification, and makes interpretations based upon the available palaeoenvironmental evidence. A summary of these interpretations are presented in table 43 for Cruvie, table 44 for Pitbladdo and table 45 for Methvern.

The recognition of the pollen of taxa sensitive to the type of changes in the environment that may be attributable to human activity (e.g. the creation of opening within a wooded environment, changes in soil stability and fertility, fire, trampling) is of considerable value in assessing human activity. By considering the number and range of 'anthropogenic indicators' within the pollen record and the habitats with which they are most frequently associated, it may be possible to recognise periods of human activity and possibly identify the nature of this activity.

The principal limitations of this approach are the problems associated with the selection of taxa indicative of anthropogenic activity and accurate interpretation of the patterns revealed. The selection of appropriate taxa is primarily determined by a consideration of the geographical position of the site and the current habitat preferences of the taxa present. It is assumed that the ecological requirements of each taxon will not have altered significantly during the relatively short Holocene epoch. The extent to which natural processes might produce similar patterns of change must also be considered.

1) Anthropogenic indicators were chosen primarily on the basis of the work of Behre (1981). Additional taxa that were considered potentially relevant to human activity within the study area were identified on the basis of information on primary habitats in Grime *et al.* (1988).Tables 38 and 39 show the occurrence of these taxa at the study sites.

2) The number of anthropogenic indicators occurring in each of the sites LPAZs was recorded; see Tables 40 to 42. For details of LPAZs see Chapters Five, Six and Seven.

3) The primary habitat associated with each taxa was recorded, based on Grime *et al.* (1988). See Tables 38 and 39 for a summary of the preferred habitats.

4) The distribution of the indicator species based on their primary habitat classes was applied to each study sites. Figures 78 to 82.

The information presented in figures 78 to 82 is based on the number of indicators associated with each habitat type for that period and does not reflect pollen abundance. Examination of the pollen diagrams clearly shows that individual indicators are not strongly represented in the pollen record and frequently represent less than 1% TLP. It is recognised that interpretations based on small numbers of grains should be viewed with a degree of caution and the extent to which changes may be reflecting natural vegetation dynamics carefully considered.

8:3:2 - Cruvie.

The sediments recovered from Cruvie span the period from ca. 9750 to 3870 BP. This section considers the palaeoenvironmental evidence for human activity at Cruvie during the Mesolithic and Neolithic. Table 40 shows that 15 taxa that may be indicative of some form of human activity are recorded at Cruvie, 14 of these taxa were defined on the basis of Behre (1981) and one additional indicator (*Taraxacum*) is also recorded in LPAZ Cb. No indicators associated with the practice of arable farming are recorded at this site, although it is recognised that owing to the poor pollen

Table 38 Principal anthropogenic indicators as defined in Behre (1981) recorded at the sites under investigation.

Taxa	**Cruvie**	**Pitbladdo**	**Methvern**	**Most strongly associated habitat**
Hordeum	-	*	*	2
cf. Cannabis	-	*	*	2
Centaurea	-	*	-	1
Caryophyllaceae	*	*	*	1,2,3,4,7,8
Rumex acetosa/sella	*	*	*	7
Compositae	*	*	*	7
Gramineae	*	*	*	4
Trifolium	-	*	-	4,6,7
Ranunculaeae	*	*	*	4
Plantago lanceolata	*	*	*	4
Plantago media/major	*	*	*	7
Cyperaceae	*	*	*	8
Umbelliferae	*	*	*	4
Succisa pratensis	-	-	*	4
Juniperus communis	*	-	-	5
Pteridium aquilinum	*	*	*	6
Polypodium vulgare	*	*	*	5,6,8
Chenopodiaceae	*	*	*	7
Urtica	-	*	*	7
Artemisia vulgaris	*	*	*	7

Key	
- = Absent from site.	
* = Present at site.	
1 = Winter cereals.	2 = Summer cereals and root crops.
3 = Fallow land.	4 = Wet meadows and pastures.
5 = Dry pastures (heaths etc.).	6 = Grazed forest.
7 = Footpath and ruderal communities.	8 = Natural communities (esp. bogs).

Table 39 Additonal anthropogenic indicators applicable to this area of Scotland recorded at the sites under investigation.

Taxa	Cruvie	Pitbladdo	Methvern	Most strongly associated habitat
Papaver undiff.	-	*	*	Arable / waste
Papaver rhoeas	-	-	*	Arable
Papaver dubium	-	-	*	Wasteland
Hypericum pulchrum	-	*	*	Pasture
Agrimonia eupatoria	-	*	-	Wasteland
Anagallis arven	-	*	*	Arable
Pedicularis	-	*	-	Pasture
Rhinanthus	-	-	*	Pasture
Scabiosa	-	*	-	Pasture
Cirsium	-	*	-	Pasture
Anthemis	-	*	-	Arable / waste
Centaurea	-	*	-	Wasteland
Taraxacum	*	*	*	Pasture / waste

Table 40 Number and distribution of anthropogenic indicators recorded in L.P.A.Z.'s at Cruvie.

LPAZ's	Behre (1981)	Other	Overall total
eii	12	0	12
ei	6	0	6
d	7	0	7
ciii	7	0	7
cii	5	0	5
ci	7	0	7
b	10	0	10
a	2	1	2
Total	14	1	15

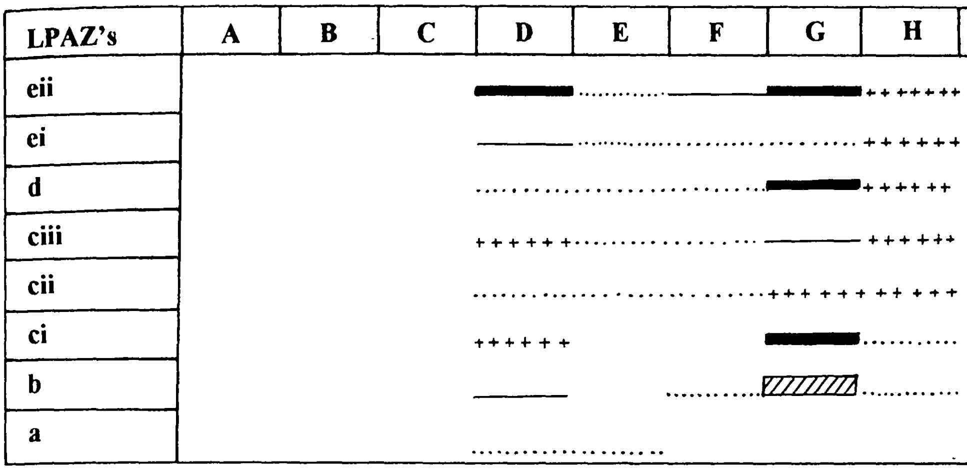
Table 41 Number and distribution of anthropogenic indicators recorded in L.P.A.Z.'s at Pitbladdo.

LPAZ's	Behre (1981)	Other	Overall total
h	13	3	16
gii	12	2	14
gi	14	2	16
f	16	2	18
eii	14	1	15
ei	16	1	17
d	12	0	12
c	14	4	18
bii	6	0	6
bi	6	0	6
a	5	1	6
Total	18	10	28

Table 42. Number and distribution of anthropogenic indicators recorded in L.P.A.Z.'s at Methvern.

LPAZ's	Behre (1981)	Other	Overall total
j	12	4	16
I	11	1	12
h	12	0	12
giii	10	0	10
gii	12	1	13
gi	13	1	14
fii	7	1	8
fi	11	0	11
e	12	0	12
d	7	2	9
c	6	0	6
bii	6	0	6
bi	6	0	6
aiii	2	0	2
aii	2	0	2
ai	7	1	8
Total	17	7	24

Figure 78
Anthropogenic indicators adapted from Behre (1981) and applied to Local Pollen Assemblage Zones at Cruvie.



A = Winter cereals	E = Dry pastures
B = Summer cereals and root crops	F = Grazed forest
C = Fallow land	G = Footpath and ruderal communities
D = Wet meadows and pastures	H = Natural communities (esp. bogs)

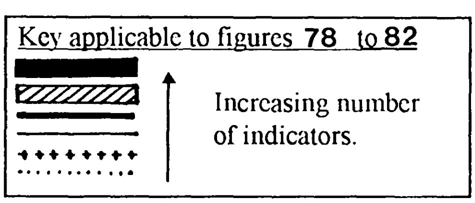
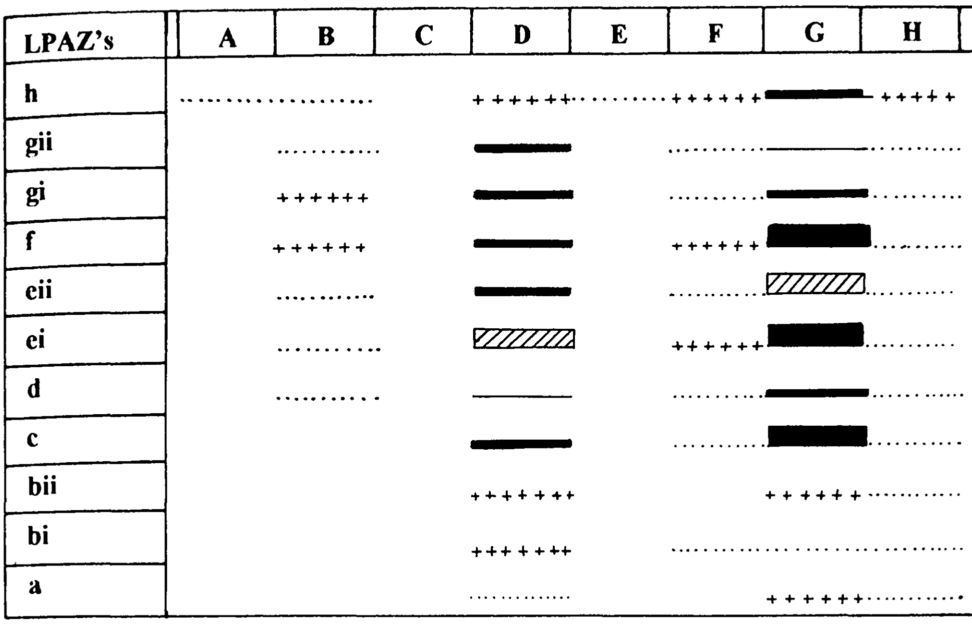


Figure 79

Anthropogenic indicators adapted from Behre (1981) and applied to Local Pollen Assemblage Zones at Pitbladdo.



A = Winter cereals	E = Dry pastures
B = Summer cereals and root crops	F = Grazed forest
C = Fallow land	G = Footpath and ruderal communities
D = Wet meadows and pastures	H = Natural communities (esp. bogs)

Figure 80

Additional anthropogenic indicators applied to Local Pollen Assemblage Zones at Pitbladdo.

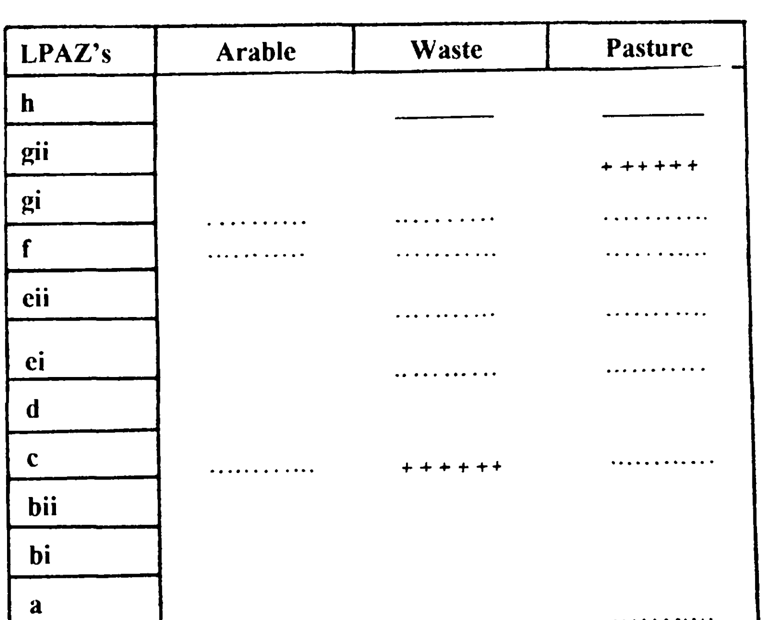


Figure 81

Anthropogenic indicators adapted from Behre (1981) and applied to Local Pollen Assemblage Zones at Methvern.

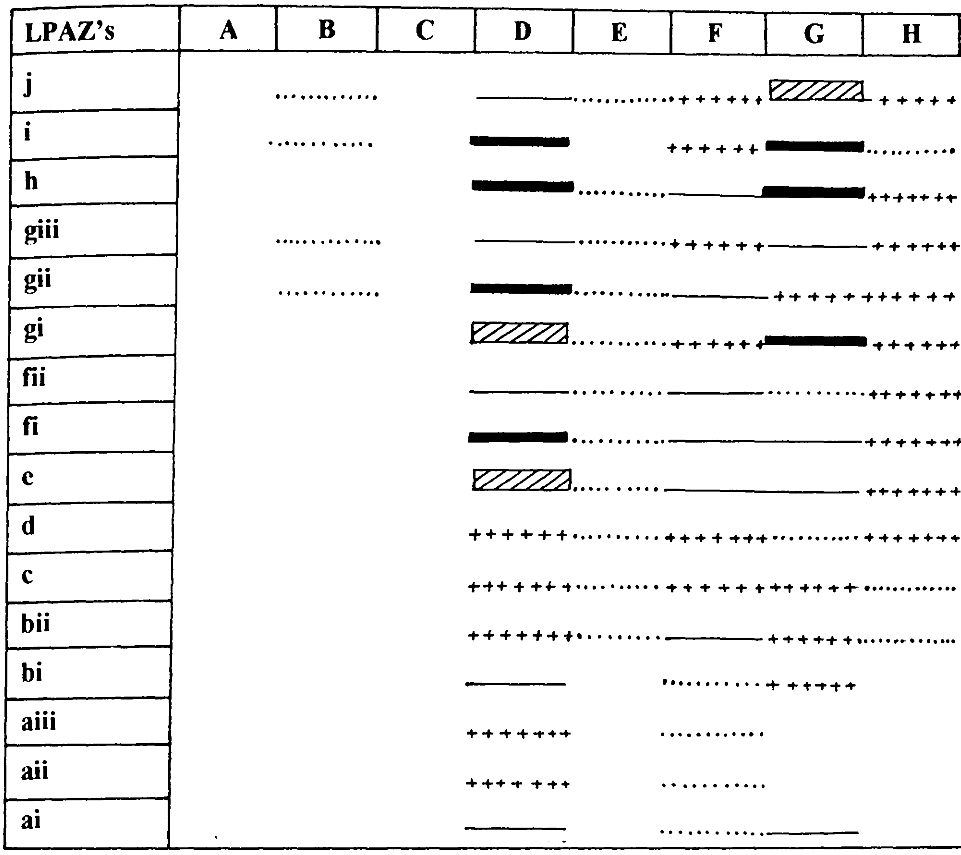
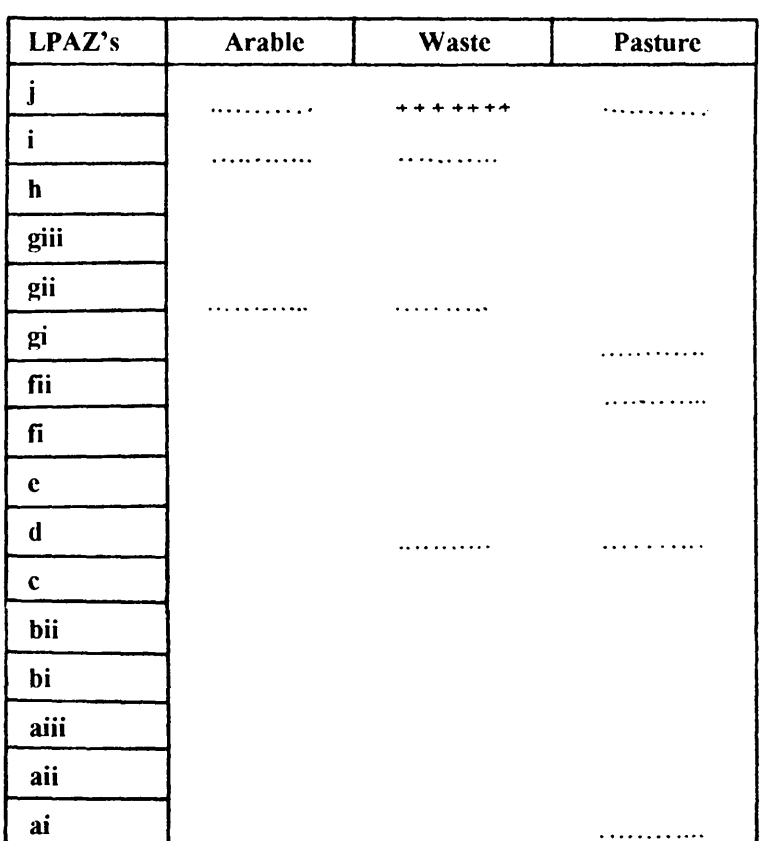


Figure 82

Additional anthropogenic indicators applied to Local Pollen Assemblage Zones at Methvern.



productivity and dispersal capacity of cereal pollen (Hall 1989), its absence does not mean that arable farming was not occurring, merely that it has not been registered in the pollen record.

The anthropogenic indicators present at Cruvie appear to reflect the presence of a range of habitat types (see figure 78), with ruderal communities being most strongly represented in LPAZs Cb to Cd (9250 +/- 80 to ca. 5610 BP). The low number of indicators recorded (two) in LPAZ Ca (ca. 9750 to 9250 +/- 80 BP) reflect an open landscape with little established soil cover and a limited range of plant taxa in the immediate post-glacial period, prior to the arrival of arboreal taxa. The high number of indicators present (10) in LPAZ Cb (8480 +/- 70 to 9250 +/- 80 BP) is considered to reflect the colonisation of the area by open ground and ruderal taxa, in response to improving climatic and edaphic conditions, before the establishment of a woodland canopy of *Betula* and *Corylus*, rather than extensive human activity. However, the possibility that humans were active within this area during this period can not be entirely discounted, as the available archaeological evidence suggests that the earliest known sites in this area date from ca. 8050 +/- 250 BP (Morton - Coles 1983), within the age range of PAZ Cb.

Between ca. 8480 and 5610 BP (LPAZs Cci to Cei) the number of indicators recorded remains relatively stable, fluctuating between five and seven (table 40). Each of these zones is dominated by indicators associated with ruderal communities, although fluctuations in the representation of other groups suggest that a number of changes are occurring during this period.

The range of indicators recorded in LPAZ Cci (8480 to 7630 BP) suggests that in addition to ruderal communities, wet meadow / pasture and natural bog communities are also present. The overall palynological and sedimentary record shows little change during this period and it is considered that these indicators are reflecting natural patterns of change.

In LPAZ Ccii (7630 to 7010 BP) the number of indicators associated with wet meadows / pastures decreases, whilst the number of indicators associated with natural bog communities increases to a level that is maintained throughout the remainder of the core. Indicators reflecting the presence of dry pastures are recorded for the first time since LPAZ Ca, and taxa indicative of grazed forest are also recorded. Fluctuations in the percentage representation of mineral matter suggest some sediment movement was occurring during this period and both pollen concentrations and Gramineae pollen values increase. However, it is not possible to determine whether these changes represent human activity or natural processes.

In LPAZ Cciii an increase is recorded in taxa associated with wet meadows / pasture and ruderal communities, whilst the number of taxa from other groups shows no change. A further increase in indicators of ruderal communities and a decrease in indicators of wet meadows / pastures are recorded in LPAZ Cd (ca. 6220 and 5610 BP). Minor fluctuations in the representation of arboreal pollen taxa during these period suggest that small openings were being created within the woodland environment. However, there are no large-scale changes in either the sedimentary or palynological record and the cause of these disturbances remains unclear.

The overall number of anthropogenic indicators does not increase in LPAZ Cei (ca. 5610 to 4990 BP). However, the habitat preferences of those recorded does suggest a change in conditions. A decrease in taxa associated with ruderal communities and a twofold increase in taxa associated with wet meadows / pastures (figure 78) may reflect a substantial increase in open ground, suggestive of the clearance of woodland by a human population. The presence of indicators associated with wet meadows / pastures suggests the implementation of pastoral agriculture. The overall reduction in arboreal pollen taxa, increase in Gramineae pollen and peak in mineral material (at ca. 5020 BP) recorded during this period are considered to support this proposal.

The uppermost zone at Cruvie (LPAZ Ceii) contains 12 anthropogenic indicators, double the number recorded in LPAZ Cei. The numbers of indicators associated with grazed forest, ruderal and wet meadows / pasture communities all increase, while indicators associated with dry pastures show no changes between Cei and Ceii. These changes may be indicative of a further increase in human activity and a possible expansion in the area utilised for agricultural activity. Fluctuations in arboreal pollen taxa, an increase in Gramineae pollen and further peaks in mineral material are considered to support this proposal.

8:3:3 - Pitbladdo.

The sediments recovered from Pitbladdo span the period from ca. 8120 to 3910 BP, the Mesolithic and Neolithic periods. Tables 41 shows that 28 anthropogenic indicators are recorded at Pitbladdo, 18 indicators defined on the basis of Behre (1981) and an additional 10 on the basis of their current preferred habitats (Grime *et al.* 1988).

The number and range of indicators recorded appears to suggest two distinct phases may be identified at this site. A total of six anthropogenic indicators from four of the eight recognised groups are recorded in LPAZs Pa to Pbii (ca. 8120 to 7310 BP), whilst between ca. 7310 and 3910 BP (LPAZs Pc to Ph) the number of indicators fluctuates between 12 and 18 and include seven of the eight recognised groups (figures 79 and 80).

The indicators recorded in LPAZs Pa to Pbii are considered to reflect the presence of wet meadows / pastures, ruderal and natural bog communities in the area surrounding Pitbladdo. Although it is possible that these indicators were reflecting human activity, it is considered that the lack of additional changes in either the general palynological or sedimentary records suggestive of human activity during this period imply that these indicators are probably reflecting natural changes in the plant communities surrounding Pitbladdo.

In LPAZ Pc (ca. 7310 to 5530 BP) there is a marked increase in the number of taxa associated with the occurrence of wet meadows / pastures and ruderal communities and a total of 18 anthropogenic indicators are recorded. This increase is considered to reflect an increase in the quantity of open areas within the predominantly wooded landscape. The small fluctuations recorded in the representation of arboreal pollen taxa and the absence of any changes in the sedimentary record support this proposal. However, on the basis of the available data, it was not possible to determine whether these open areas were a product of woodland dynamics or limited human activity.

LPAZ Pd (ca. 5530 to 5240 BP) records the first indicators of arable farming at this site (figure 50), and cereal-type pollen grains are recorded in all the subsequent zones at this site, suggesting continued cultivation throughout the early Neolithic period (ca. 5530 to 3910 BP). It is suggested that changes in the palynological record during this period including increases in the percentage representation of Gramineae pollen, fluctuations in arboreal and shrub pollen taxa and an increase in the pollen concentrations of arboreal taxa indicate agricultural activity in a predominantly woodland environment. The absence of changes in the sedimentary record suggests that this activity did not result in soil erosion, or was sufficiently distant from the site as to be 'invisible' in the sedimentary record.

Only limited changes are recorded in the number and range of indicators during LPAZs Pd to Pgii (5530 to 3950 BP), suggesting that levels of activity during this period remained relatively constant. Changes in both the palynological and sedimentary records suggest that a mixed agricultural economy was operating throughout this period. The overall increase in the representation of Gramineae pollen suggests a gradual increase in the area of land cleared of woodland.

The increase in indicators associated with the cultivation of summer cereals during LPAZs Pf and Pgi (ca. 4610 to 3990 BP) suggests a slight intensification in activity. This proposal is supported by the increases in Gramineae pollen and the reduction in arboreal pollen taxa. The peaks in mineral matter recorded suggest erosion close to the site, which might be linked to the cultivation of adjacent land. However, owing to the limited amount of available data, this proposal remains tentative.

A consideration of other palaeoenvironmental data from this site relating to the high levels of mineral matter and mechanically damaged pollen (Chapter six) appears to indicate that LPAZ Ph relates to a habitat similar to the modern period, placing the end of the record at ca. 3950 BP. The presence of indicators associated with winter cereal cultivation and dry pasture supports this proposal. The fields surrounding the site are currently used for pasture and both summer and winter cereal production. Until recently the site itself supported an active bog community (group H), whilst the margins of the fields surrounding the site supported a thriving ruderal community (group G).

8:3:4 - Methvern.

The sediments recovered from Methvern provide the most complete Holocene record recovered during this study and span the period from ca. 10530 to 20 BP. Table 42 shows that 24 anthropogenic indicators are recorded at Methvern, 14 indicators identified by (Behre 1981) and applicable to this area of Scotland and an additional seven upon the basis of their current preferred habitat (Grime *et al.* 1988).

The range of indicators recorded at Methvern reflects the presence of a variety of habitat types (figures 81 and 82). It is possible to recognise several different phases of disturbance. The high number of indicators (eight) recorded in the basal zone at Methvern (LPAZ Mai - ca. 10530 to 9910

BP) is considered to reflect the presence of a generally open landscape before the establishment of extensive woodland cover. As arboreal taxa become established the number of indicators falls, although the continued presence of taxa associated with wet meadows / pastures and grazed forest during LPAZs Maii and Maiii (ca. 9910 to 8890 BP) suggests that small areas of open land did remain.

The limited indications of disturbance and absence of archaeological evidence suggest that human activity was not locally extensive during this area during this part of the Mesolithic, and any activity is largely 'invisible' in the palaeoenvironmental record. The indicators of grazed forest may be attributed to grazing of wild animals in natural woodland clearings, although this assessment remains open to revision.

The increase in indicators associated with the presence of wet meadows / pastures and ruderal communities in LPAZ Mbi suggests an increase in the amount of open ground. The general palynological record suggests that these indicators may have been located in the open area that appears to have existed in the area surrounding the coring site, although the possibility that the indicators are reflecting open areas within the woodland is not discounted.

Indicators linked to the presence of grazed forest and ruderal communities recorded in LPAZs Mbii to Md (ca. 8110 to 5890 BP) suggest an increase in the levels of disturbance during this period. Changes in the general palynological record also indicate small disturbances. However, the cause of these remains unclear. The sedimentary record records no evidence of human activity during this period.

LPAZ Me records a significant increase in the number of indicators (rising from 9 to 12). It is suggested that the increases in taxa primarily associated with wet meadows / pastures, grazed forest and ruderal communities may reflect an increase in disturbance in the area surrounding the site, although the exact nature and cause of this disturbance remains unclear. The increase in indicators recorded in LPAZ Me is similar to the increase recorded in LPAZ Pc at Pitbladdo in the period immediately before the first occurrence of cereal pollen.

The first indicators associated with the cultivation of cereals are recorded in LPAZ Mfi (ca. 5600 to 4810 BP). The presence of cereal pollen in this zone is the first tangible evidence of arable cultivation at this site, and cereal pollen is recorded intermittently throughout the rest of the core. The general palynological record indicates the presence of a dense mixed woodland during this period and Gramineae pollen values remain low. It is suggested that, although agricultural activity may have been occurring in this period, the dominant woodland taxa effectively prevented much non-woodland pollen reaching the coring point.

During LPAZs Mfi to Mj (ca. 5600 to 20 BP) the number of indicators recorded fluctuates between 8 and 16, suggesting variations in the degree of disturbance. Overall indicators associated with wet meadow / pasture, dry pasture or natural bog communities show few changes.

During LPAZ Mfii a reduction in the number of indicators associated with the presence of wet meadows and pasture is recorded. This zone corresponds to the major *Ulmus* decline at Methvern, but there is little indication of changes in other pollen curves or sedimentary data such as might indicate human activity. Gramineae pollen values remain low and cereal-type pollen is absent from the record. It is suggested that, although humans may have been active during this period, it is not possible to determine the nature or extent of this activity on the basis of the available evidence.

The period between ca. 4710 and 3620 BP (LPAZs Mgi and Mgii) records an increase in indicators associated with wet meadow / pastures and ruderal communities. However, the general palynological and sedimentary records provide only limited evidence of disturbance and the nature of any local activity during this period remains unclear. The presence of cereal-type pollen in LPAZ Mgiii (ca. 3620 to 3300 BP) suggests that arable agriculture was occurring during this period. The cereal pollen in LPAZ Mgiii represents the only significant difference between the three zones and it is suggested that agricultural activity may have been occurring throughout this period, but that detection of this activity is largely absent owing to pollen filtration by the woodland canopy.

During LPAZ Mh (ca. 3300 to 1830 BP) an increase in the indicators associated with wet meadows / pastures and ruderal communities is recorded. This corresponds to a decline in the representation of arboreal pollen taxa and Gramineae pollen. It is suggested that this reflects increased woodland clearance in the area surrounding Methvern.

The overall number of indicators recorded in LPAZ Mi is the same as in LPAZ Mh. However, a recovery in arboreal pollen taxa suggests a possible reduction in the intensity of agricultural activity. The increases recorded are not considered indicative of total woodland regeneration and the presence of cereal-type pollen (*Hordeum* type) indicates the continuation of some agricultural activity.

The final LPAZ at Methvern (LPAZ Mj - ca. 1160 to 20 BP) shows a further increase in indicators associated with ruderal communities, which corresponds with a gradual increase in Gramineae pollen and a decline in arboreal pollen taxa. The changes are interpreted as representing the establishment of an increasingly open landscape supporting both arable and pastoral agriculture.

8:3:5 - Intersite correlation.

The sites examined in this study showed considerable variation in size. It is generally acknowledged that site size has important impact on the sources of pollen input at a site (Chapter 2). Approximately 30 % of the pollen input at the smallest site, Cruvie, 15 % at Pitbladdo and 12 % at the largest site, Methvern, will probably have come from a local pollen source (based on Jacobson and Bradshaw 1981). These differences will affect the sensitivity of the sites to local and regional spatial patterns of change and provide a range of spatial perspectives.

Examination of tables 43 to 45, which summarise the inferred human activity at Cruvie, Pitbladdo and Methvern, show that the three sites record similar patterns of changing activity. A comparison of the general level and type of activity during the various archaeological periods is shown in table 46.

Table 43 Summary of inferred human activity at Cruvie.

Local pollen assemblage zones (LPAZs)	Estimated age range in 14C years	Vegetation	Inferred land use
Ceii	4990 - 3870 BP 3040 - 1920 bc ca. 1120 years	Fluctuations in arboreal pollen, increases in herbaceous taxa. Increase in Gramineae at top of zone.	Pastoral farming activity within a wooded environment.
Cei	5610 - 4990 BP 3660 - 3040 bc ca. 620 years	Fall in arboreal pollen, peak in Gramineae. Classic *Ulmus* decline in second half of zone.	Limited pastoral farming may have been initiated.
Cd	6220 - 5610 BP 4270 - 3660 bc ca. 610 years	High levels of arboreal pollen, low levels of Gramineae. Limited occurrence of disturbance indicators.	Small scale disturbances of an indeterminate nature.
Cciii	7010 - 6220 BP 5060 - 4270 bc ca. 790 years	First *Ulmus* decline. Small changes in arboreal taxa. Limited Gramineae. *Rumex* consistently present.	Small scale disturbances of an indeterminate nature.
Ccii	7630 - 7010 BP 5680 - 5060 bc ca. 620 years	Increases in *Betula* and *Ulmus*. Decline in *Corylus*. Gramineae values higher than in Cci.	No human impact recognised.
Cci	8480 - 7630 BP 6530 - 5680 bc ca. 850 years	Closed woodland arboreal taxa show small changes. Gramineae values remain low.	No human impact recognised.
Cb	9250 - 8480 BP 7300 - 6530 bc ca. 770 years	Development of *Betula* and *Corylus* woodland, disturbance reflecting open woodland canopy.	No human impact recognised.
Ca	9750 - 9250 BP 7800 - 7300 bc ca. 500 years	Open landscape during early postglacial.	No human impact recognised.

Table 44 Summary of inferred human activity at Pitbladdo.

Local pollen assemblage zones (LPAZs)	Estimated age range in 14C years	Vegetation	Inferred land use
Ph	3950 - 3910 BP 2000 - 1960 bc ca. 40 years.	Very low arboreal values, high Gramineae values, large increase in *Pinus*.	Pastoral and arable farming in an open environment. Reflecting the modern environment.
Pgii	3990 - 3950 BP 2040 - 2000 bc ca. 40 years.	*Quercus* and *Ulmus* disappear from record. Overall arboreal and Gramineae values stable. Disturbance indicators fall slightly.	Continuation of pastoral and/or arable farming at same intensity.
Pgi	4070 - 3990 BP 2120 - 2040 bc ca. 80 years.	Last recovery in arboreal taxa followed by decreases in arboreal and shrub taxa. Gramineae relatively stable.	Pastoral and/or arable farming in an increasingly open environment.
Pf	4610 - 4070 BP 2660 - 2120 bc ca. 540 years.	Gramineae values increase then fluctuate. Arboreal taxa decline slightly.	Pastoral and/or arable cultivation, varying in intensity in an increasingly open woodland environment.
Peii	4860 - 4610 BP 2910 - 2660 bc ca. 250 years.	Overall decline in arboreal taxa and increase in Gramineae.	Pastoral and/or arable cultivation, varying in intensity in a wooded environment.
Pei	5240 - 4860 BP 3290 - 2910 bc ca. 380 years.	Gramineae values increase but fluctuate. Arboreal values fluctuate. Cereal present, ruderal taxa increase.	Pastoral and/or arable cultivation, varying in intensity in a wooded environment.
Pd	5530 - 5240 BP 3580 - 3290 bc ca. 290 years.	Two *Ulmus* declines. Increase in Gramineae. First appearance of cereal-type (*Hordeum*). Fluctuations in arboreal and shrub taxa.	Pastoral and/or arable cultivation, in a predominantly wooded environment.
Pc	7310 - 5530 BP 5360 - 3580 bc ca. 1780 years.	Continuation of mixed woodland. Expansion of *Alnus*, Gramineae values low, but changes in individual arboreal curves & disturbance indicators increase.	Small scale disturbances of an indeterminate nature.
Pbii	7620 - 7310 BP 5670 - 5360 bc ca. 310 years.	Continuation of mixed *Corylus*, *Betula*, *Quercus* and *Ulmus* woodland.	No human impact recognised.
Pbi	7870 - 7620 BP 5920 - 5670 bc ca. 250 years.	Mixed *Corylus*, *Betula*, *Quercus* and *Ulmus* woodland. Low levels of Gramineae and other herbaceous taxa.	No human impact recognised.
Pa	8120 - 7870 BP 6170 - 5920 bc ca. 250 years.	Mixed woodland of *Betula* and *Corylus* following hiatus. Early part of zone dominated by *Pinus*.	No human impact recognised.

Table 45 Summary of inferred human activity at Methvern.

Local pollen assemblage zones (LPAZs)	Estimated age range in 14C years	Vegetation	Inferred land use
Mj	1160 - 20 BP AD 790 - 1930 ca. 1140 years.	Gradual increase in Gramineae. Cereal pollen present. Arboreal values fall overall, but record some fluctuations.	Open landscape of arable and pastoral farming. Occasional increases in areas of woodland.
Mi	1830 - 1160 BP AD 120 - 790 ca. 670 years.	Cereal type pollen (*Hordeum*). Recovery in *Betula* and *Alnus* . Decline in Gramineae. Increase in Ericaceae	Some arable farming. Periods of reduced farming activity.
Mh	3300 - 1830 BP 1350 bc - AD 120 ca. 1470 years.	Increase in Gramineae values. Arboreal values fluctuate but fall overall. No cereals. Slight increase in disturbance indicators.	Landscape becoming more open, possible pastoral farming.
Mgiii	3620 - 3300 BP 1670 - 1350 bc ca. 320 years.	Cereal type pollen (Hordeum). Slight increase in *Alnus* . Gramineae values remain stable.	Arable farming within a wooded environment.
Mgii	3940 - 3620 BP 1990 - 1670 bc ca. 320 years.	Gramineae values low, fluctuations in arboreal taxa. Decline in Ericaceae.	Disturbance of an indeterminate nature.
Mgi	4710 - 3940 BP 2760 - 1990 bc ca. 770 years.	Fluctuations in arboreal taxa. Increase in number of disturbance indicators. No large increases in Gramineae.	Disturbance of an indeterminate nature.
Mfii	4810 - 4710 BP 2860 - 2760 bc ca. 100 years.	First sustained *Ulmus* decline. No clear changes in other arboreal taxa. No cereals present, slight fall in disturbance indicators.	Disturbance of an indeterminate nature.
Mfi	5600 - 4810 BP 3650 - 2860 bc ca. 790 years.	Mixed woodland. Increase in Ericaceae. First appearance of cereal type (*Hordeum*). Gramineae fluctuates but low.	First indication of arable farming.
Me	5890 - 5600 BP 3940 - 3650 bc ca. 290 years.	Mixed woodland. Increase in Betula. Gramineae values low, but further rise in disturbance indicators.	Disturbance of indeterminate nature. Possible period of woodland regeneration.
Md	6630 - 5890 BP 4680 - 3940 bc ca. 740 years.	Fluctuations in arboreal taxa and Gramineae. Increase in disturbance indicators.	Increased disturbance of an indeterminate nature
Mc	7430 - 6630 BP 5480 - 4680 bc ca. 800 years.	Mixed woodland of *Betula* , *Corylus* , *Ulmus* & *Quercus* . Gramineae values fluctuate.	Small scale disturbances of an indeterminate nature.
Mbii	8110 - 7430 BP 6160 - 5480 bc ca. 680 years.	Increase in *Betula* , decrease in *Corylus* . Gramineae levels remain stable, disturbance indicators present.	Small scale disturbances of an indeterminate nature.
Mbi	8890 - 8110 BP 6940 - 6160 bc ca. 780 years.	Mixed *Corylus / Betula* woodland. Increase in disturbance indicators. Fluctuations in Gramineae values.	Small scale disturbances of an indeterminate nature.
Maiii	9380 - 8890 BP 7430 - 6940 bc ca. 490 years.	Expansion of *Corylus* leading to the formation of a mixed *Corylus / Betula* woodland.	No human impact recognised.
Maii	9910 - 9380 BP 7960 - 7430 bc ca. 530 years.	Open woodland of predominantly *Betula* . High values of Gramineae.	No human impact recognised.
Mai	10530 - 9910 BP 8580 - 7960 bc ca. 620 years.	Transition from open landscape in the early postglacial to an open predominantly *Betula* woodland.	No human impact recognised.

Table 46 A schematic diagram of human activity at the study sites.

Years BP	Cruvic	Pitbladdo	Methvern	Archaeological periods.
0			4	
1000				Medieval and post-medieval.
2000				Iron age (including Roman incursions).
3000				Bronze Age
4000	3	3	3	Neolithic
5000				
6000	2	2	2	
7000				
8000	1	1		Mesolithic
9000			1	
10000				

1 = No human impact recognised. 2 = Small scale disturbances. ▒ = No record at site.
3 = Agriculture within a wooded environment. 4 = Increasing activity.

8:3:5:1- The Mesolithic.

At all three sites, the data indicate that any human activity during the early Mesolithic period was effectively 'invisible' in the palaeoenvironmental record. During the later Mesolithic period small-scale disturbances were recorded at all sites. These disturbances were detected in the palaeoenvironmental record at Methvern slightly before disturbances were recorded at Pitbladdo and Cruvic. However, on the basis of the available data it is not possible to determine if the disturbances recorded at any of the sites are a reflection of human activity or woodland dynamics, a conclusion that concurs with Edwards and Ralston's (1984) comment that:

"hunter-gatherer penetration of Scotland's inland and upland areas away from the major river valleys is likely to have been too ephemeral to have caused detectable changes to the vegetation cover, in gross terms at least" (Edwards and Ralston 1984 p.19)

The equivocal nature of the evidence corresponds to the limited archaeological evidence for this period within the study area. Although evidence of human settlement within the study area is provided by the coastal site at Morton (Coles 1971, 1983), the area away from the prehistoric coastline contains limited evidence of human activity. The single chance find associated with the Mesolithic period, from the immediate vicinity of the sites under investigation, was recovered at Methvern (Chapter three). However, the limited and ambiguous nature of both the palaeoenvironmental and archaeological evidence prevents further interpretation.

8:3:5:2 - The Mesolithic / Neolithic transition.

Until fairly recently the *Ulmus* decline was used conveniently to split the Mesolithic and Neolithic periods, marking the division between hunter-gatherer and agricultural activity. This is no longer the case:

"the *Ulmus* decline has been relegated to a subsidiary position, most commonly thought of as lying within and not at the beginning of, the early Neolithic" (Tipping 1994 p.18).

The identification of cereal pollen within the palynological record provides the key to the recognition of agricultural activity. The presence of cereal pollen in pre-*Ulmus* decline deposits has led to the recognition that "hunter-gatherer and agricultural practices may well have co-existed and overlapped spatially and temporally" (Birks *et al.* 1988 p.182).

To date, 22 sites containing cereal pollen from pre-*Ulmus* decline deposits have been identified (Edwards 1989). Three of these sites are located in Scotland (Hulme and Shirriffs 1985 Edwards and McIntosh 1988 and Robinson and Dickson 1988). The site at North Mains in Strathallan (Hulme and Shirriffs 1985) is located approximately 10 km south-east of Methvern (Chapter one figure 3), and the presence of cereal pollen at this site indicates that agricultural activity was probably practised in the this area of Scotland prior to the *Ulmus* decline.

8:3:5:3 - The *Ulmus* decline.

The increasing number of palynological investigations that incorporate close interval pollen sampling has resulted in the recognition of multiple *Ulmus* declines (e.g. Hirons and Edwards 1986, Smith and Cloutman 1988, Whittington *et al.* 1991). At the sites under investigation two clear *Ulmus* declines were recorded at Cruvie (ca. 6400 BP and ca. 5180 to 5420 BP) and Pitbladdo (ca. 5530 to 5420 BP). At Methvern a limited decline occurs at ca. 5160 BP, followed by a clear decline at ca. 4780 BP. None of the sites shows any indication of pre-*Ulmus* decline arable agriculture. The pattern of multiple *Ulmus* declines corresponds to that recorded at other sites in the study area (Black Loch - Whittington *et al.* 1990 and Pickletillem - Whittington *et al.* 1991). The range of dates and occurrence of multiple *Ulmus* declines leads to the suggestion that successive declines may be reflecting different cause(s), and that multiple declines may be "reflecting successive attacks on different areas of the elm population" (Tipping 1994 p. 21).

It has been suggested (e.g. Smith 1981) that the *Ulmus* decline may be related to climate change, soil deterioration, disease, anthropogenic activity or a combination of these causal factors. The range of dates recorded for this event at the study sites, suggests that the main influence on the timing of the decline was local factors rather than a more regional causal event. The lack of changes in the representation of other pollen taxa recorded during the first decline at Cruvie and both declines at Methvern is considered to suggest that these declines might have occurred as a result of pathogen attack. The presence of elm bark beetle *Scolytus scolytus*, a vector for *Ceratocystus ulmi* in deposits of Neolithic age (Girling 1988) provides evidence of a plausible vector of disease. Indications of human activity in the palaeoenvironmental record concurrent with the declines at Pitbladdo and the second decline at Cruvie suggest humans may have played some role in the decline of *Ulmus* at these sites. However, it is considered possible that the declines recorded could be reflecting a combination of factors and the proposal that human populations may have been moving into areas opened by disease (Rackham 1980), or that anthropogenic activity was aiding the spread of disease (Robinson and Dickson 1988), is not discounted at these sites.

8:3:5:4 - The Neolithic period.

The palaeoenvironmental record for the Neolithic period at the sites under investigation suggests agricultural activity within a wooded environment. The nature of this activity is difficult to assess as the representation of cereal-type pollen shows considerable variations. It is possible that the presence / absence of cereal is reflecting changes in either the nature or intensity of activity. However, it is also possible that these changes are due to the low productivity and dispersal of cereal pollen (Hall 1984) and the problems of detecting activity in a wooded environment (Tauber 1965, Edwards 1979, Vuorela 1985). It is suggested that the fluctuations in arboreal pollen levels, intermittent occurrence of cereals and gradual increase in the representation of Gramineae pollen reflect variable but progressively increasing human activity during the Neolithic. On the basis of the available data it is not clear if the changes were reflecting a pattern of shifting agriculture (Berglund 1986) or incorporated forest farming in which woodland management for grazing played a role (Goransson 1986, Edwards, 1993).

In comparison with the Mesolithic period, the level of archaeological evidence relating to the Neolithic period also suggests an increase in the levels of human activity. The range of monuments throughout eastern lowland Scotland (Chapter three, figure 24) suggests the presence of an active population, and remains relating to the Neolithic have been recorded in the vicinity of both Pitbladdo and Methvern. The absence of both cereal pollen and Neolithic archaeological remains in the immediate vicinity of Cruvie might indicate that there was a lower level of activity in this area. However, it is equally feasible that is simply reflecting deficiencies in the palaeoenvironmental and / or archaeological records. The overall similarities between the inferred level of activity at all sites based upon the palaeoenvironmental and archaeological record suggests that anthropogenic activity was occurring throughout the study area during the Neolithic.

Determining the extent to which humans may have used to fire to drive game and/or create a more open landscape to provide browse or improve hunting (Simmons 1975, Mellars 1976, Simmons and Innes 1985) during the Mesolithic and as part of agriculture practices during the Neolithic period is difficult to determine as:

"the presence of charcoal in pollen preparations merely tells us that combustible materials have been ignited, and not that fires have been used in any particular way by man." (Edwards 1989 p.148).

A discussion of the microscopic charcoal record at the sites under investigation was undertaken in section 8:1. This section highlighted an increased incidence of fire events during the period of ca. 4090 to 3920 at Pitbladdo and ca. 4640 and 4460 BP at Methvern. It is suggested that the increase in the representation of charcoal and short periods between peaks in charcoal (section 8:1 tables 30 and 31) may be reflecting the use of fire by a human population. However, on the basis of the available evidence this proposal remains tentative.

8:3:5:5 - The later prehistoric and historic periods.

The sedimentary record at both Cruvie and Pitbladdo ended during the later Neolithic, and Methvern is the only site with a record relating to the later prehistoric and historic periods. Investigation of this period of time was not a primary aim of this research and only a limited number of analyses was undertaken from these periods.

The identification of archaeological remains attributed to the Bronze age, Iron age and later historic periods is considered to reflect the continued presence of humans throughout these periods. The palaeoenvironmental record at Methvern records an increase in the area of open land during the Bronze Age which corresponds to the increase recorded at Black Loch (Whittington *et al.* 1990). There is no evidence at Methvern to suggest that land was abandoned during this period in response to a deterioration in climatic conditions (Burgess 1989) and it is suggested that current archaeological investigations might wish to focus upon the detection of settlement sites for this period.

The archaeological evidence for human activity during the Iron Age indicates a continued presence, including the period spanning the Roman incursions into Scotland. Whittington and Edwards (1993) have suggested that the landscape surrounding Black Loch was "in a state of retrograde agricultural activity" (1993 p.22) during the period of the Roman incursions. The palynological record at Methvern does not record a similar decline. However, this may in part reflect the limited data available for this period.

The palynological evidence for the Medieval and post-Medieval periods suggests a continued human presence in the area which corresponds well to the evidence of ongoing activity recorded in the archaeological record. The presence of castles at both Cruvie and Pitbladdo reflects the presence of a substantial human population and it is considered that these populations were responsible for the removal of peat from both of these sites.

Chapter Nine

Conclusions and future work.

This project aimed to investigate the patterns of vegetation development across a small geographical area and to evaluate the degree of variation that occurr within that area. The study has successfully reconstructed the vegetation history at the three study sites. Comparisons between the individual investigations has revealed that although general trends may be recognised on a regional scale, local environmental conditons are of primary importance, resulting in a complex mosaic of vegetation, rather than uniform patterns of distribution. These findings have clear implications for the reconstruction of the vegetational history of Scotland; the degree of diversity recorded clearly indicates the need for a network of closely spaced palaeoenvironmental sites across Scotland if a true picture of patterns of vegetation development is to be established.

The evidence of human activity in the palaeoenvironmental record suggested that human activity may have had a limited impact on the environment during the Mesolithic. The identification of anthropogenic activity during this early period is problematic as the available data are limited and open to different interpretations. It is considered that the integration of data from as many parameters as possible provides the best opportunity for the identification of human activity during the Mesolithic period. Anthropogenic activity was more clearly identified during the Neolithic period during which time arable activity was practised in this area of Scotland. The period from the Neolithic onwards records an increasing pattern of exploitation. The palaeoenvironmental and archaeological records showed a similar pattern of increasing activity. However, the information provided by the palaeoenvironmental record was less fragmentary in nature and provided information for periods when the archaeological record was absent within the local area or poorly defined.

The potential for the recognition of palaeoclimatic signals in the palaeoenvrionmental record was clearly shown during this study. The integration of data relating to changes in the representation of microscopic charcoal and aquatic pollen taxa, across the study area, revealed a number of apparently contemporaneous variations, which are considered to reflect a strong palaeoclimatic signal. The evidence indicated a phase of dry climatic conditions in the immediate postglacial period and a series of climatic fluctuations between ca. 8000 and 7000 BP.

The recognition of a climatic signal from the palaeoenvironmental record is not simple; however, it is considered that interpretations based upon a range of parameters and intersite correlation may represent a way of identifying climate change. The further investigation of the apparant climate signals identified during this study is considered a priority. The integration of additional lines of palaeoenvironmental evidence; in particular humification data, from suitable raised bog sites, will hopefully allow further clarification of the patterns of palaeoclimatic change that occured during the Holocene.

The absence of tephra from the sites investigated prevented an assessment of the value of tephra as an effective dating tool within an integrated investigation. However, the paucity of tephra at the sites investigated has led to the formulation of a hypothesis linking patterns of orographic rainfall and tephra deposition. The implementation of a programme to clarify the boundaries of tephra deposition in Britain and to test this hypothesis vigorously forms another area for future research.

Overall this project has clarified issues relating to local patterns of vegetation and emphasised the importance of local environmental controls. It has also highlighted the value of an integrated approach to palaeoenvironmental research and has shown that the incorporation of all available data allows the recognition of spatial trends and a level of interpretation that is not achievable from single-site palynological investigations.

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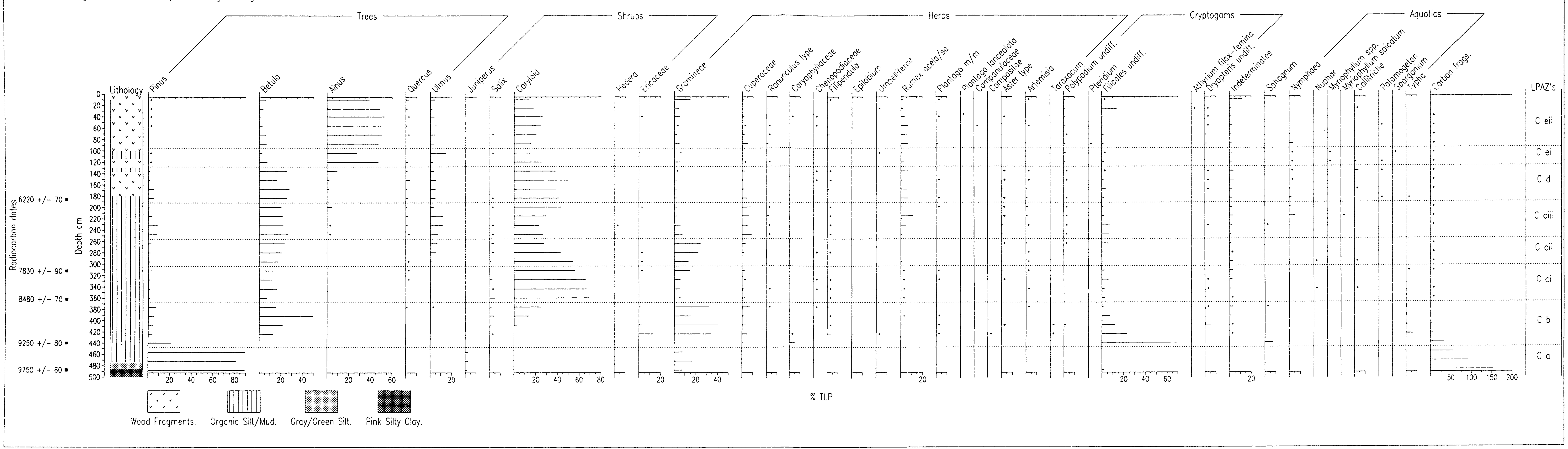


Figure 39 Pollen percentage diagram for Cruvie.

Paula Milburn
Palaeoenvironmental investigation into aspects of the vegetation history of north Fife and south Perthshire, Scotland.
Ph.D. - Department of Archaeology
University of Edinburgh

Figure 40. Pollen concentration diagram for Cruvie.

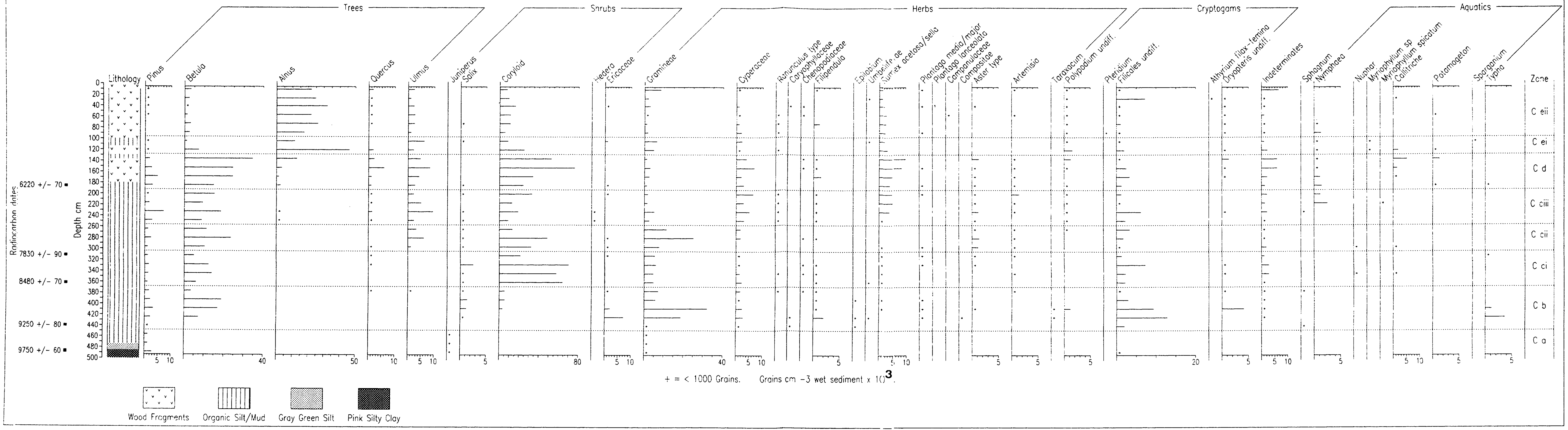


Figure 50 Pollen percentage diagram for Pitbladdo.

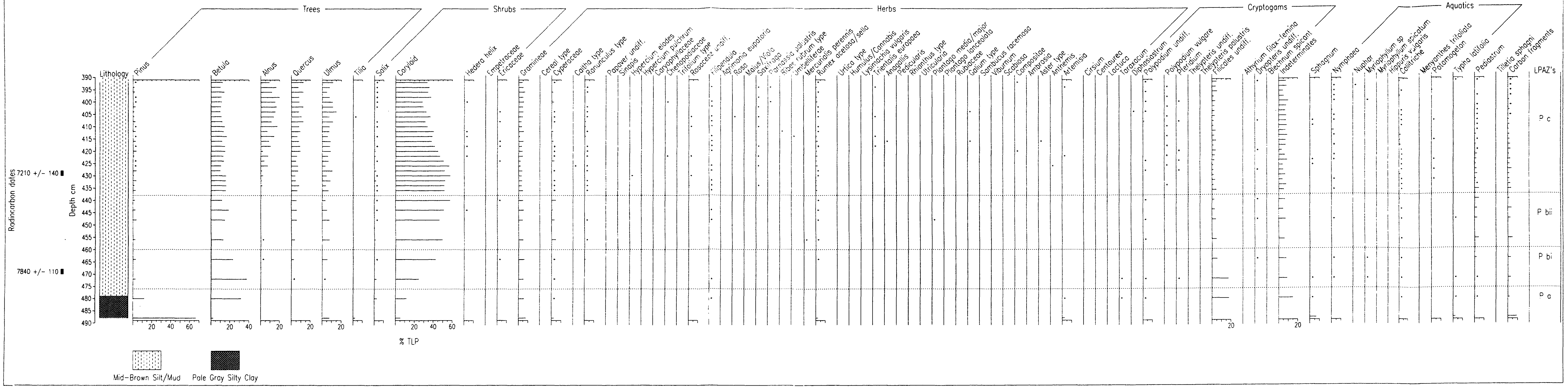
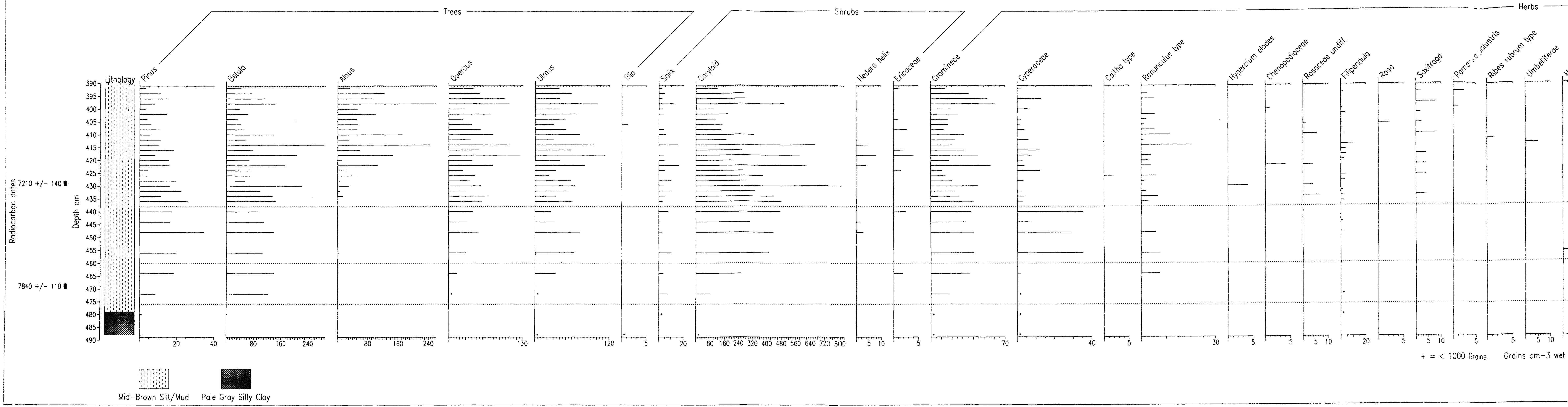


Figure 51 Pollen concentration diagram for Pitbladdo.



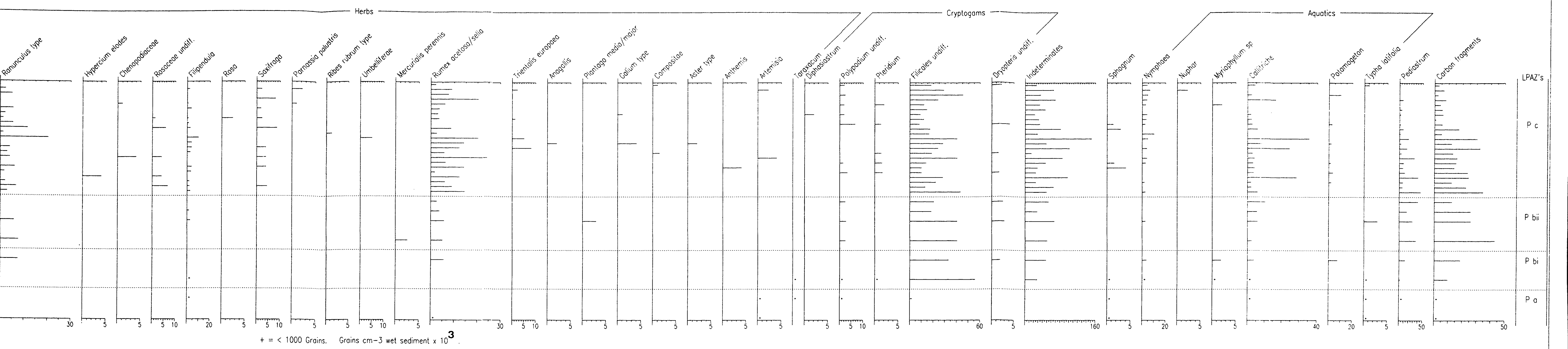

Herbs
Cryptogams
Aquatics
Ranunculus type
Hypericum elodes
Chenopodiaceae
Rosaceae undiff.
Filipendula
Rosa
Saxifraga
Parnassia palustris
Ribes rubrum type
Umbelliferae
Mercurialis perennis
Rumex acetosa/sella
Trientalis europaea
Anagallis
Plantago media/major
Galium type
Compositae
Aster type
Anthemis
Artemisia
Taraxacum
Diphasiastrum
Polypodium undiff.
Pteridium
Filicales undiff.
Dryopteris undiff.
Indeterminates
Sphagnum
Nymphaea
Nuphar
Myriophyllum sp
Callitriche
Potamogeton
Typha latifolia
Pediastrum
Carbon fragments
LPAZ's
P c
P bii
P bi
P a
+ = < 1000 Grains. Grains cm-3 wet sediment x 10 3

Figure 52 Pollen percentage diagram for Pitbladdo.

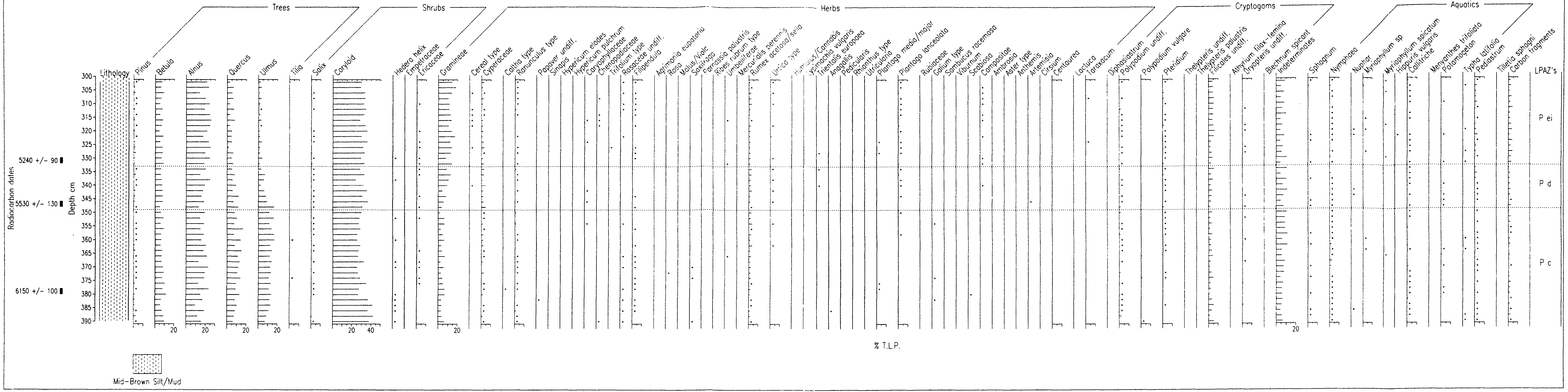
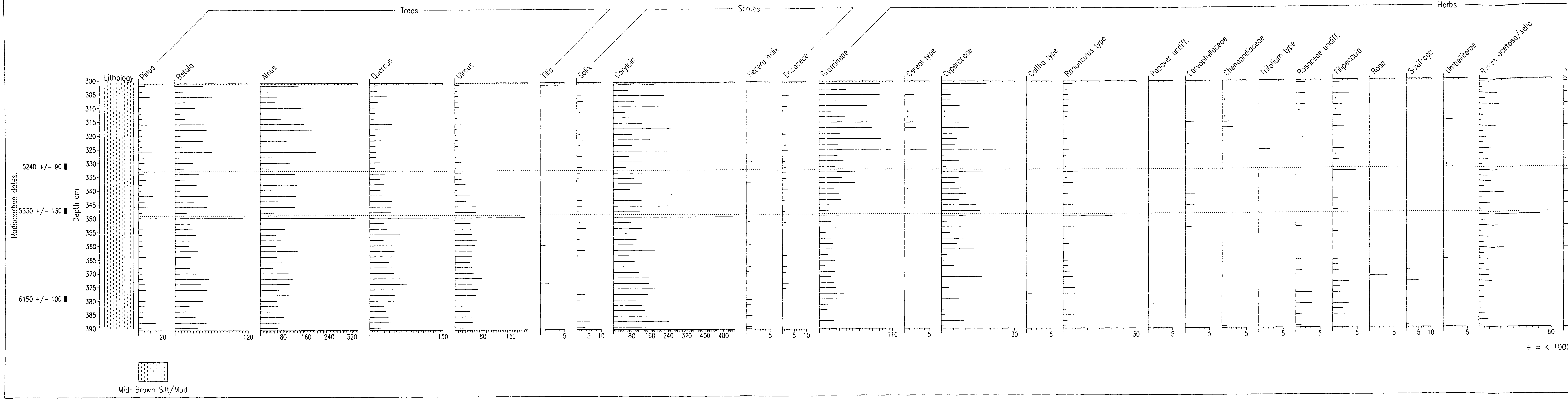
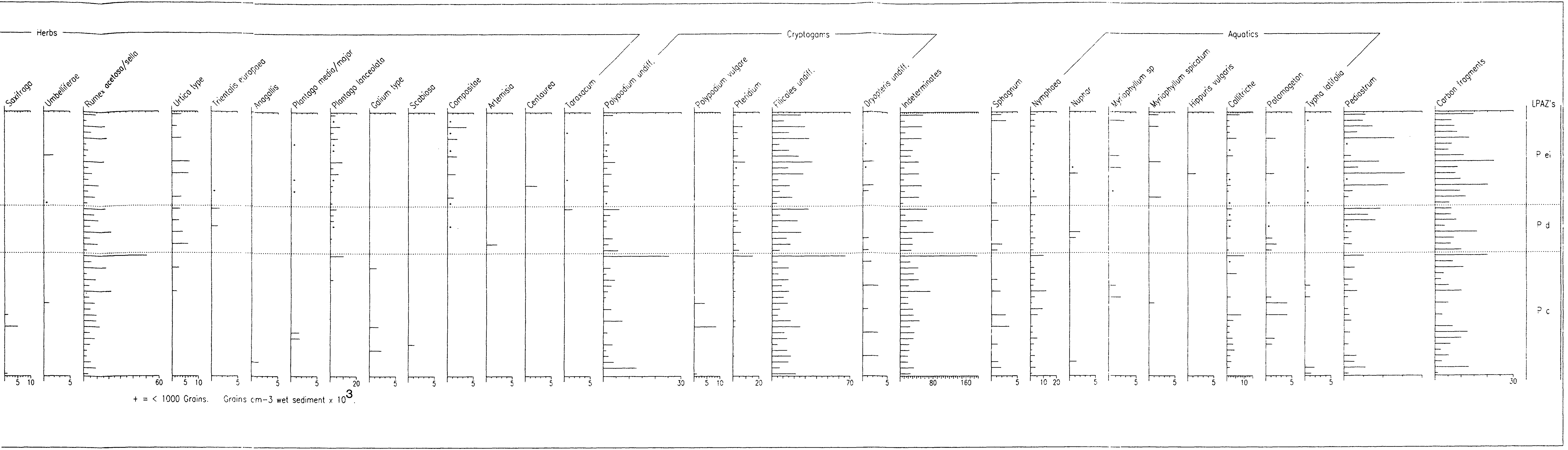


Figure 53 Pollen concentration diagram for Pitbladdo.





Herbs
Cryptogams
Aquatics
Saxifraga
Umbelliferae
Rumex acetosa/sella
Urtica type
Trientalis europaea
Anagallis
Plantago media/major
Plantago lanceolata
Galium type
Scabiosa
Compositae
Artemisia
Centaurea
Taraxacum
Polypodium undiff.
Polypodium vulgare
Pteridium
Filicales undiff.
Dryopteris undiff.
Indeterminates
Sphagnum
Nymphaea
Nuphar
Myriophyllum sp
Myriophyllum spicatum
Hippuris vulgaris
Callitriche
Potamogeton
Typha latifolia
Pediastrum
Carbon fragments
LPAZ's
P ei
P d
P c
5 10
5
60
5 10
5
5
5
20
5
5
5
5
5
5
30
5 10
20
70
5
80 160
5
10 20
5
5
5
5
10
5
5
30
+ = < 1000 Grains. Grains cm-3 wet sediment x 10³.

Figure 54 Pollen percentage diagram for Pitbladdo.

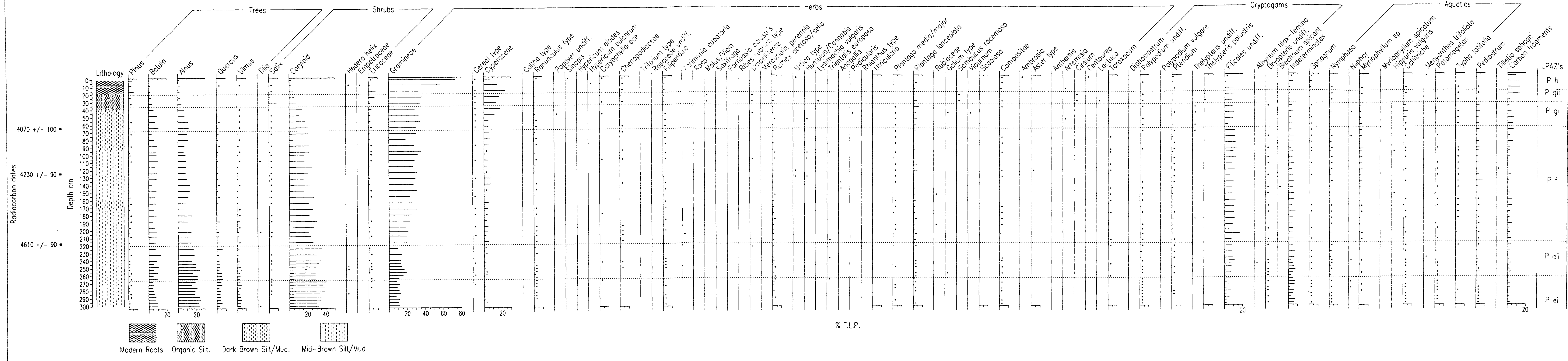
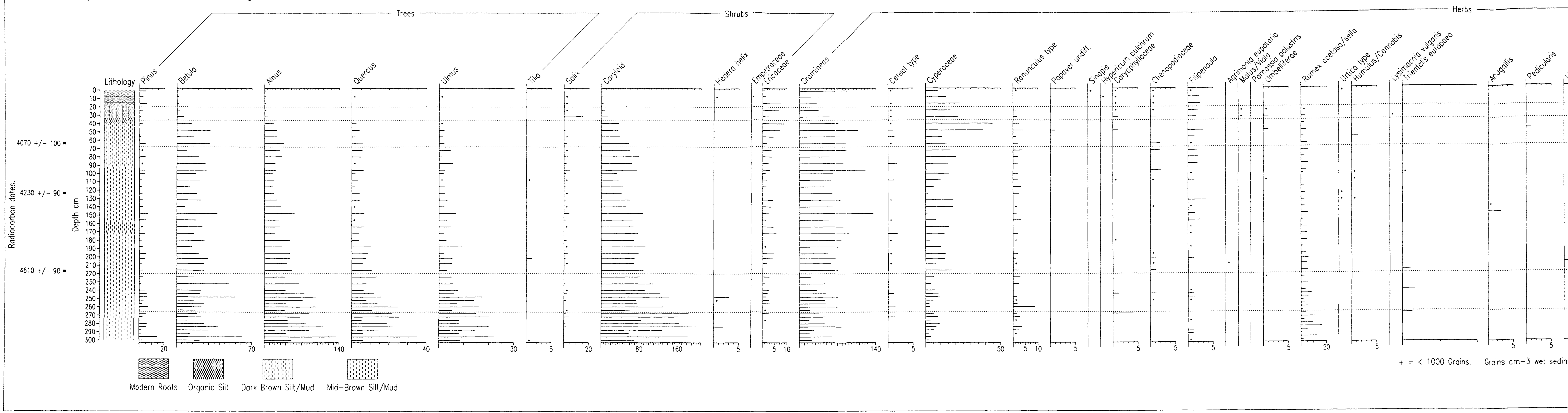
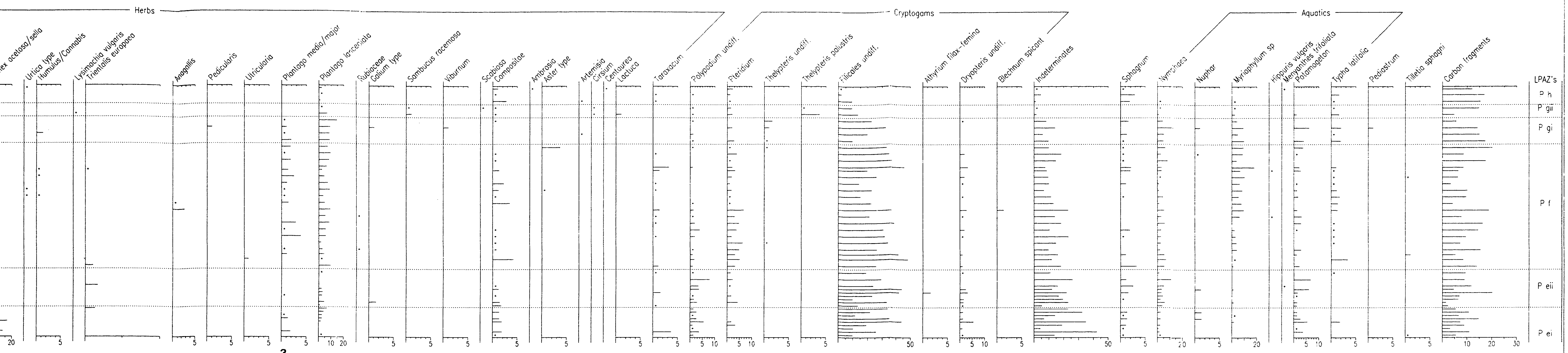


Figure 55 Pollen concentration diagram for Pitbladdo.





\+ = < 1000 Grains. Grains cm−3 wet sediment x 10^3.

Figure 65 Pollen percentage diagram for Methvern.

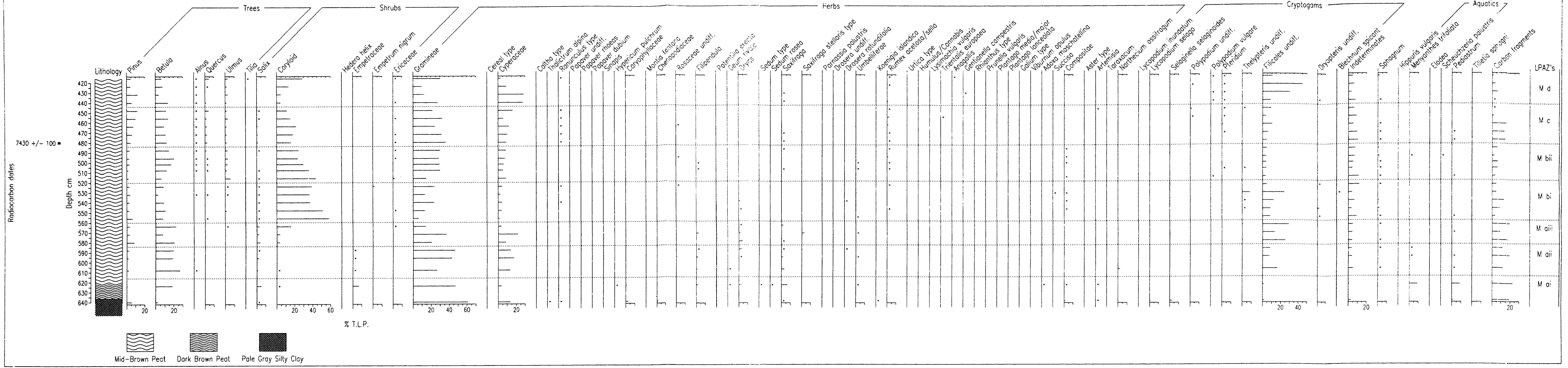


Figure 66 Pollen concentration diagram for Methvern.

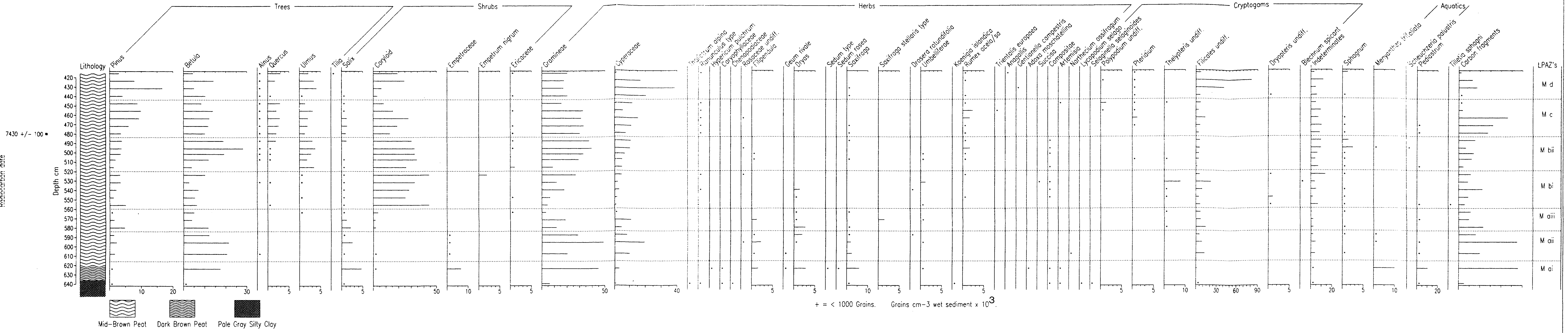


Figure 67 Pollen percentage diagram for Methvern.

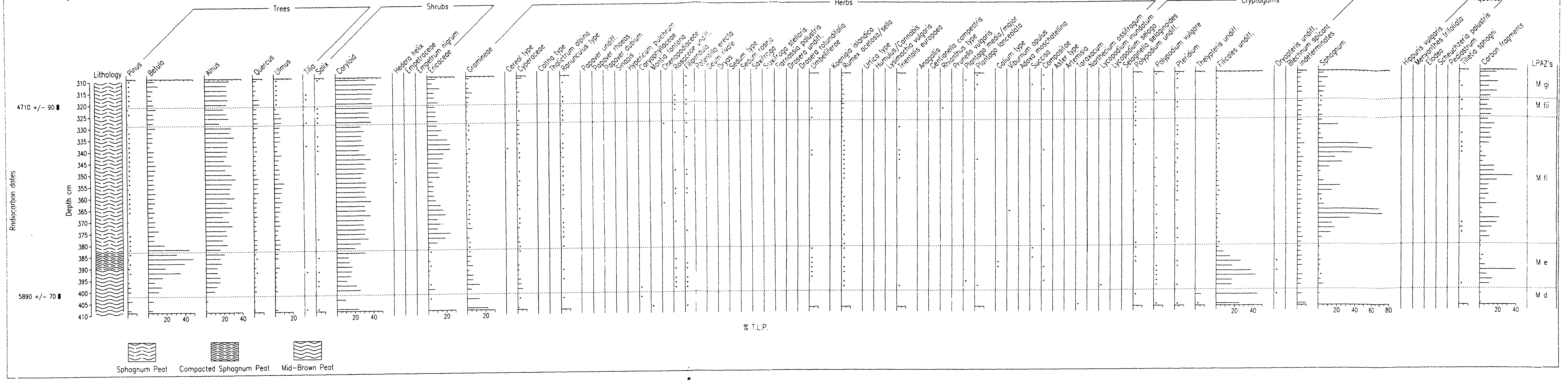
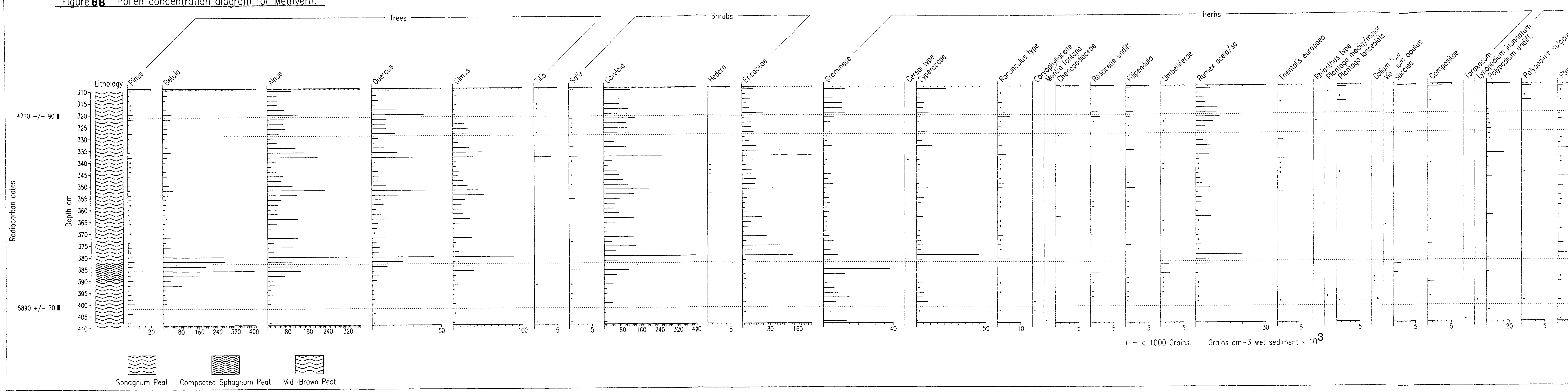


Figure 68 Pollen concentration diagram for Methvern.



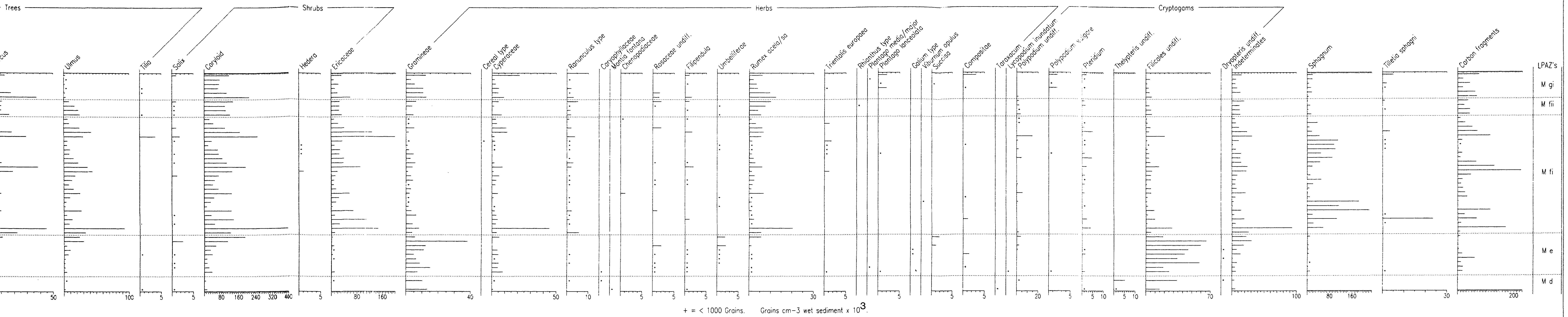

Trees
Shrubs
Herbs
Cryptogams
Ulmus
Tilia
Salix
Coryloid
Hedera
Ericaceae
Gramineae
Cereal type
Cyperaceae
Ranunculus type
Caryophyllaceae
Montia fontana
Chenopodiaceae
Rosaceae undiff.
Filipendula
Umbelliferae
Rumex acetosa
Trientalis europaea
Rhianthus type
Plantago media/major
Plantago lanceolata
Galium type
Viburnum opulus
Succisa
Compositae
Taraxacum
Lycopodium inundatum
Polypodium undiff.
Polypodium vulgare
Pteridium
Thelypteris undiff.
Filicales undiff.
Dryopteris undiff.
Indeterminates
Sphagnum
Tilletia sphagni
Carbon fragments
LPAZ's
M gi
M fii
M fi
M e
M d
+ = < 1000 Grains. Grains cm−3 wet sediment x 10³.

Figure 69 Pollen percentage diagram for Methvern.

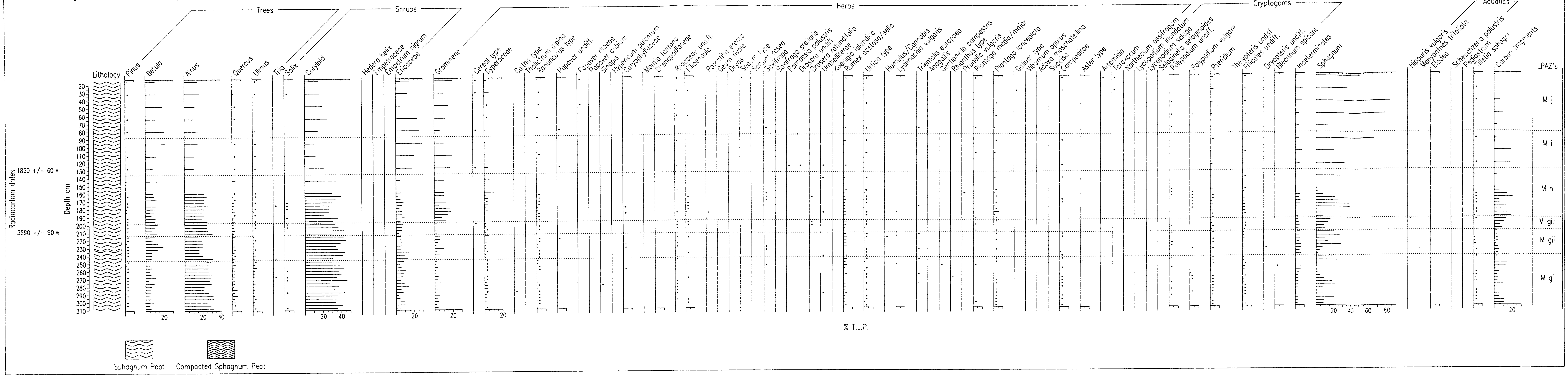
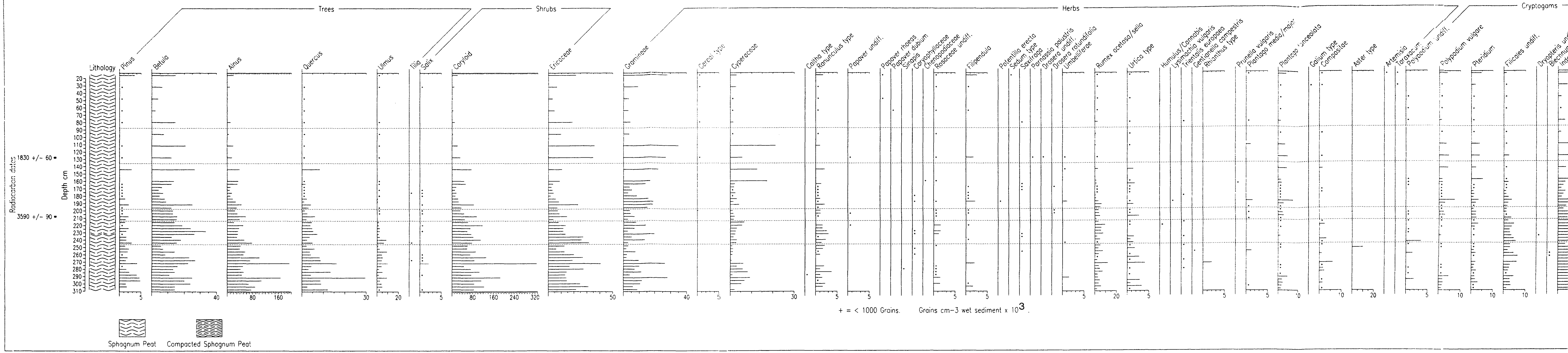
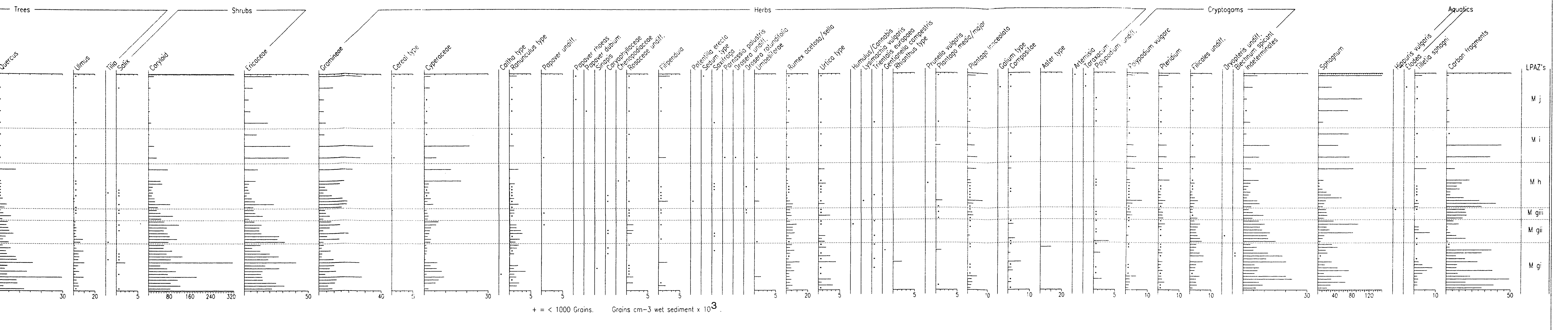


Figure 70 Pollen concentration diagram for Methvern.





Trees
Shrubs
Herbs
Cryptogams
Aquatics
Quercus
Ulmus
Tilia
Salix
Coryloid
Ericaceae
Gramineae
Cereal type
Cyperaceae
Caltha type
Ranunculus type
Papaver undiff.
Papaver rhoeas
Papaver dubium
Sinapis
Caryophyllaceae
Chenopodiaceae
Rosaceae undiff.
Filipendula
Potentilla erecta
Sedum type
Saxifraga
Parnassia palustris
Drosera undiff.
Drosera rotundifolia
Umbelliferae
Rumex acetosa/sella
Urtica type
Humulus/Cannabis
Lysimachia vulgaris
Trientalis europaea
Gentianella campestris
Rhianthus type
Prunella vulgaris
Plantago medic/major
Plantago lanceolata
Galium type
Compositae
Aster type
Artemisia
Taraxacum
Polypodium undiff.
Polypodium vulgare
Pteridium
Filicales undiff.
Dryopteris undiff.
Blechnum spicant
Indeterminates
Sphagnum
Hippuris vulgaris
Elodea
Tilletia sphagni
Carbon fragments
LPAZ's
M j
M i
M h
M giii
M gii
M gi
+ = < 1000 Grains.
Grains cm−3 wet sediment x 10³

Palaeoenvironmental investigation into aspects of the vegetation history of north Fife and south Perthshire, Scotland.

Volume Two

Paula Milburn

Submitted in satisfaction of the requirements for the degree of Ph.D. in the University of Edinburgh. 1996.

Abstract

Results from the palaeoenvironmental investigations into the Holocene vegetation history of three sites in eastern lowland Scotland are presented. Two of the sites, Cruvie and Pitbladdo, are located in north Fife; the third site, Methvern is situated in south Perthshire.

Cruvie is located in a kettle-hole and provides data extending from the Late-glacial to ca. 3900 BP. Pitbladdo is a former bog and cores from this site provide data on the period from ca. 8000 to 3900 BP. Methvern is a well-maintained raised bog and provides data that spans the entire Holocene.

Relative, concentration and pollen preservation data are supplemented by loss-on-ignition, pH and magnetic susceptibility analyses. Microscopic charcoal data are also recorded. Radiocarbon dates allow comparisons to be made between similar events at different sites, resulting in a detailed picture of temporal and spatial patterns of palaeoecological change within a small geographical area.

Attention is focused upon the identification of human impact on the environment during the early to mid Holocene. The influences of succession and climate change in determining patterns of vegetation change are also considered. The data obtained indicate that human activity may have had a limited impact on the environment in this area during the Mesolithic, but no unequivocal evidence is recorded. Anthropogenic impacts are more clearly identified during the Neolithic period and from the late Neolithic/early Bronze Age, human activity is considerable and includes pastoral and mixed farming.

The value of tephra as a dating tool in this area of eastern Scotland is considered. The absence of tephra at the three sites investigated has led to the formulation of a hypothesis linking patterns of orographic rainfall and tephra deposition within Scotland.

The study highlights the difficulties of determining the causal factors of vegetation change and the limitations of palaeoecological data in the identification of anthropogenic activity during the early Holocene. The recognition of climate signals is discussed and the routine counting of microscopic charcoal at all sites is proposed. It is suggested that further research is required to clarify the boundaries of tephra deposition in Britain. Finally the diverse patterns of change recorded within the study area emphasise the need for a network of closely spaced and well dated palaeoenvironmental sites covering the regions of Scotland, leading to the recognition of local patterns of environmental change.

Chapter Plan

Presented in Volume One.

Part One: Aims, background and methods.

Continuation of Chapter Plan

Continuation of Chapter Plan

Part Two: Results and preliminary discussion.

Continuation of Chapter Plan

Part Three: Discussion and conclusions.

Continuation of Chapter Plan

Presented in Volume Two

List of Figures

List of Figures continued

List of Figures continued

List of Tables

List of Tables continued

List of Plates

List of X - radiographs

List of Appendices - Presented in Volume Two.

Appendix One - Processing techniques.

Appendix Two - Data tables.

[redacted]

Acknowledgements.

I would like to thank the following people for the assistance they provided during the course of this study: the various landowners in north Fife and south Perthshire, who kindly allowed access to their land; the Radiocarbon Laboratories of S.U.R.R.C. at East Kilbride, particularly Dr G. Cook, Dr J. Shore, Dr M. Cressey and Mr I. Morrison; the undergraduates of Edinburgh and Glasgow University, for assistance in the field; Dr R. Tipping, for assistance in pollen identification and field work; Dr G. Coles and Dr A Dugmore, for their encouragement throughout this project; Dr J. Bunting, for reading the text, Miss H. Crossley, for numbering figures and tables. This research was undertaken with a grant from the Natural Environment Research Council.

Appendix One - Processing techniques.

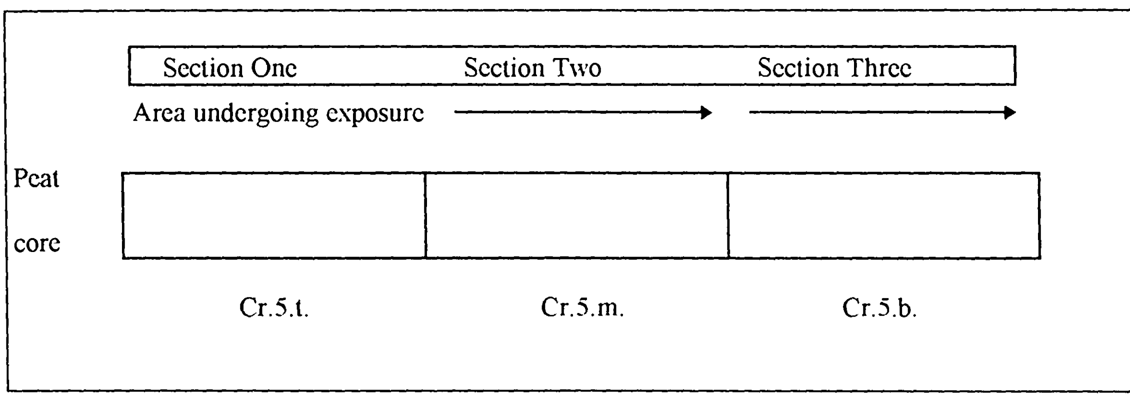
The following appendix contains details of the laboratory processing techniques used during this study.

X-radiography (After Dugmore and Newton 1992).

X-radiography is a and non-destructive method of locating structures and changes in sediment density invisible to the naked eye (Hamblin 1962, Butler 1991). X-radiography was undertaken at the British Geological Survey in Edinburgh using a SCANRAY 120L machine.

Method

Entire 1m sample cores were placed in the SCANRAY 120L machine and X-rayed in three sections. Each section was labelled using metal letters and numbers placed beneath the key area, to enable later identification of X-ray plates. For example Cr.5.t. = Cruvie, 5 - 6m, top section.



Radiation intensity and exposure times were varied depending upon the thickness of the peat, the best results were obtained with a potential of 35kV, an accelerating current of 2nA and an exposure time of 80 seconds.

Following exposure the plates were developed in a darkroom following standard photographic procedures. Negatives were produced at a scale of 1:1 and placed on a light table for examination.

Magnetic susceptibility.

Magnetic susceptibility is an easily measured parameter which gives an indication of the 'magnetizability' of sediment, determined by the abundance of ferro-magnetic minerals (Roberts 1989). Measurements were undertaken using a Bartington Instruments Magnetic Susceptibility meter and this procedure follows that in the 1983 User Manual.

Method

I) Measurements were undertaken using a low frequency core scanning loop. The loop was fixed firmly to a non magnetic surface.

ii) The meter was turned on, zeroed and drift rate checked. A drift of +/- 0.1 over 5 successive readings represents an acceptable level. Electromagnetic interference gives rise to 'noise' causing non-monotonic variations in the drift rate, seriously diminishing accuracy and requires the relocation of the sensor.

iii) Once located in an area giving acceptable levels of drift the meter was set on the 0.1 CGS calibration scale and the following procedure undertaken.

a) Zero machine.

b) Note the value before sample insertion (=A)

c) Insert sample and ignore next number to allow stabilisation.

d) Note next two numbers (= B and C).

e) Remove sample and ignore next number.

f) Note closing blank reading (= D).

g) An initial reading of R_1 is recorded as $\frac{(B + C) - (A + D)}{2}$

iv) Each core was inserted into the loop and readings taken at 1 cm intervals.

v) Results were checked by repeating the procedure moving in the opposite direction, giving a reading of R_2. In the absence of electro magnetic interference R_1 and R_2 should produce comparable values.

vi) Values are plotted as volume susceptibility.

Pollen Preparation

(After Andersen 1960, Erdtman 1960, Benninghoff 1962, Bonny 1972, Faegri and Iversen 1975, Berglund and Ralska-Jasiewiczowa 1986, Moore *et al.* 1991).

Method

I) A standard volume of sediment (1 ml) was subsampled. The volume was calculated by measuring the displacement of distilled water in a graduated centrifuge tube.

ii) A standard volume (40 μl) of exotic pollen (*Lycopodium clavatum*) suspension was added to each sample. Each sample was then mixed thoroughly, centrifuged at 3000 rpm for 5 minutes and the supernatant decanted.

iii) 6 ml of 10 % HCl was added to each sample. The samples were mixed and allowed to stand until any effervescence had stopped. The samples were then centrifuged at 3000 rpm for 5 minutes and the supernatant decanted. 6 ml of distilled water was added to each sample followed by mixing, centrifuging and decanting of the supernatant. (This step resulted in the removal of any calcium carbonate from the sediments).

iv) 6 ml of 10 % KOH was added to each sample. The samples were mixed and placed in a boiling water bath for 20 minutes. The samples were then centrifuged at 3000 rpm for 5 minutes and the supernatant decanted. 6 ml of distilled water was added to each sample followed by mixing, centrifuging and decanting of the supernatant. (This step resulted in the removal of humic acids from the sediments).

v) 6 ml of 10% $Na_7(PO_3)_4$ was added to each sample. The samples were mixed and placed in a boiling water bath for 10 minutes. The samples were then centrifuged at 3000 rpm for 5 minutes and the supernatant decanted. 6 ml of distilled water was added to each sample followed by mixing, centrifuging and decanting of the supernatant. (This step deflocculated the sediments).

vi) Very coarse and very fine particles were then removed from the sediments by sieving. Samples were sieved (using distilled water) through a 150μm sieve with a 5μm sieve placed below. Residues retained in the 5μm sieve were returned to the centrifuge tubes. The samples were then centrifuged at 3000 rpm for 5 minutes and the supernatant decanted.

vii) 6 ml of concentrated glacial acetic acid was added to each sample. The samples were mixed, centrifuged at 3000 rpm for 5 minutes and supernatant decanted. 6 ml of acetolysis mixture* was added to the samples which were mixed and placed in a boiling water bath for 2 minutes. The samples were then centrifuged and the supernatant decanted. The samples were resuspended in 6 ml of glacial acetic acid, mixed, centrifuged and the supernatant decanted. Finally the samples were resuspended in 6 ml of distilled water, mixed, centrifuged and supernatant decanted.

* The acetolysis mixture was made by combining concentrated acetic anhydride and concentrated sulphuric acid in the ratio of 9:1. To avoid difficulties caused by adverse reactions the mixture was made fresh each day; the sulphuric acid was added to the acetic anhydride (the colour yellow indicating excessive H_2SO_4). Any waste was poured into running water.

viii) 6 ml of 2-methylpropan-2-ol and 1 drop of stain (0.2 % safranin) was added to each sample. The samples were mixed, allowed to stand for 1 minute, centrifuged at 3000 rpm for 5 minutes and the supernatant decanted. 6 ml of 2-methylpropan-2-ol was added to each sample. The samples were mixed, centrifuged and the supernatant decanted. The samples were then transferred to small storage tubes using 2-methylpropan-2-ol, centrifuged at 2000 rpm for 10 minutes and the supernatant decanted.

ix) A small amount of silicone oil (12500 centistokes) was added to the samples. The samples were then centrifuged at 2000 rpm for 10 minutes. Cotton wool plugs were placed in each tube to prevent any atmospheric contamination. The samples were then placed in a previously warmed drying cabinet overnight allowing any excess alcohol to evaporate. The sample tubes were then sealed to prevent drying.

x) During slide preparation silicone oil (12500 centistokes) was used as the mounting medium, and slides were sealed using clear nail varnish.

The production of an exotic marker suspension.

In order to determine the pollen concentration of a sediment (grains per cm^3) several techniques may be applied; volumetric methods (Dimbleby 1961, Davis and Deevey 1964, Davis 1965, 1966) weighing methods (Jorgensen 1967, Peck 1974) and the use of exotic marker grains (Benninghoff 1962, Mathews 1969, Bonny 1972, Maher 1972, 1981). The advantages and disadvantages of each method were considered by Peck (1974) who concluded that

"as a measure of reproducibility of results, there is little to choose between the preparation methods tested" (p. 580).

The procedure adopted during this study involved the addition of exotic marker grains at the start of the standard pollen processing technique. The exotic pollen suspension was added prior to processing in order to ensure that any loss of pollen during processing was accompanied by the loss of an equal proportion of exotic pollen, a practice advocated by Maher (1972) and Peck (1974).

At the time this study was undertaken no standard *Lycopodium* spore tablets were available and therefore a suspension of exotic pollen was prepared for use. A single large batch was used in all standard pollen preparations, therefore ensuring comparability between samples and sites.

Method

I) Fresh *Lycopodium clavatum* pollen was acetolysed. This removed any waxes or fats, which may have resulted in problems due to differential flotation of coated grains (Mathews 1969).

ii) The exotic pollen was then stained with safranin. The addition of stain to the pollen at this stage ensured that it was possible to differentiate between the *Lycopodium clavatum* added to samples as an exotic marker and any subfossil *Lycopodium* occurring in the samples. The double stained exotic *Lycopodium* was clearly darker than any of the subfossil pollen which had been stained once during processing.

iii) An assay of exotic pollen was made in distilled water and prepared in a 500 ml round-bottomed flask. Two magnets were added to the suspension, which was then stoppered.

iv) The flask was then placed on a magnetic stirrer running at a constant speed and once homogenised added to the samples awaiting processing.

In order to ensure comparability between samples it was essential that the exotic suspension was completely homogenised as "a considerable source of error can lie in the possible non-homogeneity of the exotic pollen suspension" (Bonny 1972 p. 394). An investigation by Tipping (1985) suggested that "for individual researchers the period required to achieve mixing may well differ dramatically" (p. 127).

The degree of homogenisation was assessed through the use of a haemocytometer. Samples were removed from the suspension using clean pipettes, placed in the haemocytometer and the number of grains present within the graticule counted.

Thirty samples were extracted from the main suspension and used to measure concentrations. The exotic pollen suspension was stirred first for a two hour period (which did not produce reliable results) and secondly for a four hour period. Samples extracted after four hours showed only limited variations and it was considered that in this case homogenisation was complete.

The exotic pollen suspension was stirred for four hours prior to its addition to all of the samples undergoing pollen processing. Calculation of the total assay of the exotic suspension within 95% confidence limits was made using the equation of Bonny (1972 p. 395).

Sample Preparation for Tephra Analysis - Extraction of tephra from organic deposits.
(After Dugmore *et al.* 1992, Pilcher and Hall 1992 and Hall *et al.* 1994).

1) Extraction.

i) A vertically continuous series of 4 cm long samples was extracted from the peat core. The samples were removed using a scalpel and tweezers, the scalpel and tweezers being cleaned thoroughly with distilled water between samples.

ii) The samples were placed in clearly labelled beakers which were sealed with cling film. The samples were stored in a cold store at approximately 3°C until required.

2) Acid digestion.

i) The samples were placed in labelled conical flasks (250 ml).

ii) The samples were then covered with concentrated H_2SO_4 (approximately 50 ml.).

iii) Small amounts of concentrated HNO_3 were then added to the samples, one drop at a time. The samples boiled and emitted brown fumes as the exothermic process of digestion took place. Occasionally this reaction became violent and with rapid boiling foaming occurred; Octan-2-ol was then added to the sample to decrease the level of foaming.

iv) The samples were left overnight to digest, although once the exothermic reaction has died down and little is happening a shorter period may be acceptable (cf. Dugmore *et al.* 1992).

v) The samples were placed on a hotplate and warmed. The flasks were occasionally swirled to aid digestion. The level of foaming was carefully monitored.

vi) The samples remained on the hotplate until digestion was complete. When all organic material had been oxidised the samples became clear.

vii) The samples were removed from the heat and allowed to cool completely. Distilled water was then added to each sample, which was allowed to settle before the acid solution was drawn off. This process was repeated until the sample attained a neutral pH.

viii) Deposited sediments were pipetted from the base of each flask, then sieved through a 75 micrometre and 10 micrometre polyester mesh (to remove the large and small inorganic fractions which do not contain tephra) and placed in labelled bottles.

ix) A sample from each bottle was then examined using a microscope to determine the presence of tephra.

x) The examination was undertaken using a standard petrographic microscope at x 50 and x 100 magnification. The samples were examined in a water suspension. The presence / absence of tephra was confirmed by referral to known samples of tephra (from Althnabreac and Glengarry in Scotland) and through the supervision of other researchers with experience of tephra recognition.

Due to the absence of tephra in the 218 samples prepared no electron probe analysis was undertaken on tephra from sites investigated during this study. However, training in tephra analysis was completed using tephra samples from other Scottish sites and followed the procedure shown below.

3) Slide Preparation for geochemical analysis.

i) Each slide was frosted using 600μm grit.

ii) The slides were then cleaned in an ultrasound bath for 15 minutes and wiped with methylated spirit to remove any grit residue.

iii) The slides were labelled.

iv) The slides were warmed to approximately 75°C.

v) One drop of sample was placed on each slide using a disposable pipette and the water allowed to evaporate.

vi) Warmed resin and hardener (in a ratio of 9:1 drops) were mixed in a watch glass, added to each sample and mixed evenly.

vii) The slides were left overnight to set.

viii) The slides were then finely ground using a series of sanders. During grinding a circular motion was used to ensure even erosion, sample thickness was checked at frequent intervals using a micrometer. The stages were:

a) 100μm using 180 carborundum grit.

b) 50μm using 400 carborundum grit.

c) 25μm using 600 carborundum grit.

ix) The slides were then cleaned in an ultrasound bath containing petroleum ether for 10 minutes.

x) The slides were then polished using a standard lap polisher and diamond pastes of 6μm and 1μm.

xi) The samples were cleaned between each step.

xii) Finally the slides were cleaned in an ultrasound bath containing petroleum ether for 15 minutes.

The slides were then ready to undergo electron probe micro-analysis. Samples were analysed using a Cambridge Instruments Microscan V machine. A standard WDS (wavelength dispersive) technique, with an accelerating voltage of 20 kV and a beam of 15nA, as measured across a Faraday cup was used. In order to minimise sodium mobility, the beam was slightly defocused to about 5μm in diameter. Standards used were a mixture of pure elements, oxides and simple silica compounds.

Corrections were made for counter dead time, fluorescence, atomic number effects and absorptions using a ZAF correction program (Sweatman and Long 1969).
Nine major elements were analysed using two spectrometers and counting time of 10 seconds for each element. Total analysing time was 50 seconds.

Pretreatment of Radiocarbon samples.

Radiocarbon dating of sediments was undertaken at the Scottish University Research and Reactor Centre (S.U.R.R.C.) East Kilbride. However, pretreatments were undertaken by the author at East Kilbride and the methodology used follows that of Shore *et al* (1995).

Method

i) Samples were air dried and weighed. Any visible rootlets were removed to minimise contamination.

ii) Samples were placed in large glass beakers and NaOH added, in a ratio of 20 ml of 0.5 M NaOH per gram of peat.

iii) Samples were stirred and heated (to approximately 80°C - not boiling), and left for exactly three hours.

iv) The liquid was decanted into another beaker and then into centrifuge bottles. Samples were then centrifuged at 3000 rpm for 20 minutes.

v) More 0.5 M NaOH was added to the remaining sludge (20 ml per gram of peat).

vi) Steps iii and iv were repeated.

vii) After centrifuging the fluid was decanted from the centrifuge bottles into a large beaker. This liquid was the humic acid and fulvic acid mix. Any sediment remaining in the base of the centrifuge bottles was washed back into the main mixture of peat and alkali.

viii) The humic / fulvic acid mix was acidified by slowly adding 4 M HCl, until a precipitate began to form. Acidity was checked with litmus paper.

ix) Distilled water was then added to the sludge in the original beaker (step ii).

x) The contents of the beaker were stirred and heated for one hour.

xi) The liquid produced was then decanted and spun as in step iv.

xii) The liquid was then transferred from the centrifuge bottles to the humic / fulvic acid mix. Litmus paper was used to check that the mixture remained acidic.

xiii) Steps ix to xii were repeated four times.

xiv) Following the final water wash the sludge was acidified using 4 M HCl. This was the humin acid fraction.

xv) The humic / fulvic acid mix was allowed to settle and the clear yellow liquid at the surface was then poured off (this was the fulvic acid). The remaining brown mixture was poured into clean centrifuge bottles and spun down at 3000 rpm for 10 minutes. The separated fulvic acid was discarded following spinning and more of the acid mixture added. When all of the humic / fulvic acid mix had been centrifuged the humic acid, which had accumulated in the base of the centrifuge tubes, was washed into a clean beaker.

xvi) Both the humin and humic acid fractions were filtered using CFA grade filter fibre.

xvii) The filter papers containing the fractions were placed onto labelled clean plates and dried.

At the time of pretreatment it was unclear whether it would be possible to date a single sediment fraction, or if it would be necessary to combine the fractions to obtain sufficient carbon levels for dating. To allow all options to be retained the humin and humic acid fractions were therefore separated during pretreatment.

Following discussions with Dr G. Cook at S.U.R.R.C. it was decided that in order to obtain sufficient levels of carbon from the smallest possible amount of sediment the fractions would be combined. It was considered that the benefits of small samples (representing a limited number of years) outweighed the possible loss of precision created by the mixing of fractions. The high organic content of the sediments analysed resulted in high carbon levels and allowed dating to be successfully carried out on 2 cm and 4 cm thick slices of material.

Percentage organic content - Loss on ignition (After Belcher *et al.* 1950).

The amount of organic material incorporated in a sediment may be calculated by measuring the weight loss from a sediment after burning. Burning results in the oxidation of organic matter producing CO_2 and H_2O.

<u>Method</u>

I) Samples were air dried and passed through a 2 mm sieve.

ii) A set of crucibles were dried, weighed and labelled with a sample number.

iii) A sample was then placed into each of the crucibles and the total weight recorded.

iv) The crucibles and sediments were placed in a furnace at 550 °C for 3 hours.

v) Samples were removed and placed in a desiccator until cold (to prevent absorption of atmospheric moisture).

vi) The samples and crucibles were then re-weighed and weight loss calculated.

$$\% \text{ organic matter} = \frac{\text{sample weight prior to burning - sample weight after burning}}{\text{sample weight prior to burning}} \times 100$$

pH measurement (After Smith and Atkinson 1975)

Measurement was based on the electrometric method using a pH meter. This measured the electrical potential (in terms of hydrogen ions) of each sample via reference and sensing electrodes. The current produced by the hydrogen ions in each sample drives a meter calibrated in pH values. The pH value provides a guide to the chemical status of the sample.

Method.

i) Sample solutions were prepared by dissolving 20 g of sediment in 50 mls of distilled water and stirred regularly for 15 minutes.

ii) Buffer solutions of pH 4.0, 7.0 and 9.0 were prepared and left to stand for 30 minutes. An appropriate pH sachet was dissolved in distilled water, according to instructions supplied by the manufacturer, to produce the desired buffer.

iii) The buffers were used to calibrate a pH meter. The pH meter electrodes were immersed in the pH 4.0 buffer and the meter adjusted. The electrodes were then rinsed with distilled water, to prevent contamination and placed in the pH 7.0 buffer, to check the meters accuracy. A further check was carried out using the pH 9.0 buffer.

iv) Having calibrated the meter, the pH of the samples was measured. The electrodes were placed in the sample solution allowed to stand for 60 seconds and the pH level recorded, the electrodes were rinsed with distilled water between each reading. An average of three readings was taken.

v) Care was taken that the buffers used to calibrate the meter were at the same temperature as the samples, as different temperatures may produce different pH values.

Appendix Two - Data tables.

Table 1 Cruvic Magnetic Susceptability Readings

Depth in cm	Magnetic Susceptability	Depth in cm	Magnetic Susceptability	Depth in cm	Magnetic Susceptability
1	0	62	0	123	0
2	0	63	0	124	0
3	0	64	0	125	0
4	0	65	0	126	0
5	0	66	0	127	0
6	0	67	0	128	0
7	0	68	0	129	0
8	0	69	0	130	0
9	0	70	0	131	0
10	0	71	0	132	0
11	0	72	0	133	0
12	0	73	0	134	0
13	0	74	0	135	0
14	0	75	0	136	0
15	0	76	0	137	0
16	0	77	0	138	0
17	0	78	0	139	0
18	0	79	0	140	0
19	0	80	0	141	0
20	0	81	0	142	0
21	0	82	0	143	0
22	0	83	0	144	0
23	0	84	0	145	0
24	0	85	0	146	0
25	0	86	0	147	0
26	0	87	0	148	0
27	0	88	0	149	0
28	0	89	0	150	0.1
29	0	90	0	151	0.1
30	0	91	0	152	0.1
31	0	92	0	153	0
32	0	93	0	154	0
33	0	94	0	155	0
34	0	95	0	156	0
35	0	96	0	157	0
36	0	97	0	158	0
37	0	98	0	159	0
38	0	99	0	160	0
39	0	100	0	161	0
40	0	101	0	162	0
41	0	102	0	163	0
42	0	103	0	164	0
43	0	104	0	165	0
44	0	105	0	166	0
45	0	106	0	167	0
46	0	107	0	168	0
47	0	108	0	169	0
48	0	109	0	170	0
49	0	110	0	171	0
50	0	111	0	172	0
51	0	112	0	173	0
52	0	113	0	174	0
53	0	114	0	175	0
54	0	115	0	176	0
55	0	116	0	177	0
56	0	117	0	178	0
57	0	118	0	179	0
58	0	119	0	180	0
59	0	120	0	181	0
60	0	121	0	182	0
61	0	122	0	183	0

Table 1 Cruvie Magnetic Susceptability Readings

Depth in cm	Magnetic Susceptability	Depth in cm	Magnetic Susceptability	Depth in cm	Magnetic Susceptability
184	0	245	0	308	0
185	0	246	0	309	0
186	0	247	0	310	0
187	0	248	0	311	0
188	0	249	0	312	0
189	0	250	0	313	0
190	0	251	0	314	0
191	0	252	0	315	0
192	0	253	0	316	0
193	0	254	0	317	0
194	0	255	0	318	0
195	0	256	0	319	0
196	0	257	0	320	0
197	0	258	0	321	0
198	0	259	0	322	0
199	0	260	0	323	0
200	0	261	0	324	0
201	0	262	0	325	0
202	0	263	0	326	0
203	0	264	0	327	0
204	0	265	0	328	0
205	0	266	0	329	0
206	0	267	0	330	0
207	0	268	0	331	0
208	0	269	0	332	0
209	0	270	0	333	0
210	0	271	0	334	0
211	0	272	0	335	0
212	0	273	0	336	0
213	0	274	0	337	0
214	0	275	0	338	0
215	0	276	0	339	0
216	0	278	0	340	0
217	0	279	0	341	0
218	0	280	0	342	0
219	0	281	0	344	0
220	0	282	0	345	0
221	0	283	0	346	0
222	0	284	0	347	0
223	0	285	0	348	0
224	0	286	0	349	0
225	0	287	0	350	0
226	0	288	0	351	0
227	0	289	0	352	0
228	0	290	0	353	0
229	0	291	0	354	0
230	0	293	0	355	0
231	0	294	0	356	0
232	0	295	0	357	0
233	0	296	0	358	0
234	0	297	0	359	0
235	0	298	0	360	0
236	0	299	0	361	0
237	0	300	0	362	0
238	0	301	0	363	0
239	0	302	0	364	0
240	0	303	0	365	0
241	0	304	0	366	0
242	0	305	0	367	0
243	0	306	0	368	0
244	0	307	0	369	0

Table 1 Cruvie Magnetic Susceptability Readings

Depth in cm	Magnetic Susceptability	Depth in cm	Magnetic Susceptability	Depth in cm	Magnetic Susceptability
370	0	431	0	492	0.2
371	0	432	0	493	0.2
372	0	433	0	494	0.1
373	0	434	0	495	0.1
374	0	435	0	496	0.1
375	0	436	0	497	0.2
376	0	437	0	498	0.2
377	0	438	0	499	0.3
378	0	439	0	500	0.2
379	0	440	0	501	0.2
380	0	441	0	502	0.2
381	0	442	0	503	0.2
382	0	443	0	504	0.2
383	0	444	0	505	0.2
384	0	445	0	506	0.3
385	0	446	0	507	0.2
386	0	447	0	508	0.2
387	0	448	0	509	0.2
388	0	449	0	510	0.2
389	0	450	0	511	0.2
390	0	451	0	512	0.2
391	0	452	0	513	0.2
392	0	453	0	514	0.2
393	0	454	0	515	0.3
394	0	455	0	516	0.3
395	0	456	0	517	0.3
396	0	457	0	518	0.3
397	0	458	0	519	0.3
398	0	459	0	520	0.3
399	0	460	0	521	0.3
400	0	461	0	522	0.2
401	0	462	0	523	0.2
402	0	463	0	524	0.3
403	0	464	0	525	0.3
404	0	465	0	526	0.3
405	0	466	0	527	0.3
406	0	467	0	528	0.3
407	0	468	0	529	0.2
408	0	469	0	530	0.2
409	0	470	0	531	0.2
410	0	471	0	532	0.2
411	0	472	0	533	0.2
412	0	473	0	534	0.2
413	0	474	0	535	0.2
414	0	475	0	536	0.2
415	0	476	0	537	0.2
416	0	477	0	538	0.2
417	0	478	0	539	0.2
418	0	479	0	540	0.3
419	0	480	0	541	0.2
420	0	481	0.1	542	0.3
421	0	482	0.1	543	0.3
422	0	483	0.1	544	0.3
423	0	484	0.1	545	0.3
424	0	485	0.1	546	0.3
425	0	486	0.1	547	0.2
426	0	487	0.1	548	0.3
427	0	488	0.1	549	0.3
428	0	489	0.2	550	0.3
429	0	490	0.2	551	0.3
430	0	491	0.2	552	0.3

Table 1 Cruvie Magnetic Susceptibility Readings

Depth in cm	Magnetic Susceptability	Depth in cm	Magnetic Susceptability	Depth in cm	Magnetic Susceptability
553	0.3	614	0.2	676	0.7
554	0.3	615	0.2	677	0.7
555	0.3	616	0.2	678	0.6
556	0.3	617	0.2	679	0.6
557	0.3	618	0.2	680	0.6
558	0.3	619	0.2	681	0.6
559	0.3	620	0.2	682	0.7
560	0.3	621	0.2	683	0.7
561	0.3	622	0.2	684	0.7
562	0.3	623	0.2	685	0.6
563	0.3	624	0.2	686	0.6
564	0.3	625	0.2	687	0.6
565	0.3	626	0.2	688	0.6
566	0.3	627	0.2	689	0.6
567	0.3	628	0.2	690	0.6
568	0.3	629	0.2	691	0.7
569	0.2	630	0.2	692	0.7
570	0.2	631	0.3	693	0.7
571	0.2	632	0.3	694	0.7
572	0.2	633	0.2	695	0.7
573	0.2	634	0.2	696	0.7
574	0.2	635	0.2	697	0.7
575	0.2	636	0.3	698	0.7
576	0.2	637	0.3	699	0.7
577	0.2	638	0.3	700	0.7
578	0.2	639	0.3	701	0.7
579	0.2	640	0.3	702	0.7
580	0.2	641	0.4	703	0.7
581	0.2	642	0.4	704	0.7
582	0.2	643	0.4	705	0.7
583	0.2	644	0.4	706	0.8
584	0.2	645	0.4	707	0.8
585	0.2	646	0.5	708	0.8
586	0.2	647	0.5	709	0.9
587	0.2	648	0.5	710	0.9
588	0.2	649	0.5	711	1.2
589	0.2	650	0.5	712	1.5
590	0.2	651	0.4	713	1.8
591	0.2	652	0.4	714	1.5
592	0.2	653	0.4	715	1.2
593	0.2	654	0.3	716	0.9
594	0.2	655	0.3	717	0.9
595	0.2	656	0.4	718	0.8
596	0.2	657	0.4	719	0.8
597	0.2	658	0.3	720	0.7
598	0.2	659	0.3	721	0.7
599	0.2	660	0.3	722	0.6
600	0.2	661	0.3	723	0.6
601	0.1	662	0.4	724	0.6
602	0.1	663	0.4	725	0.6
603	0.2	664	0.5	726	0.6
604	0.2	665	0.5	727	0.6
605	0.2	667	0.5	728	0.7
606	0.2	668	0.5	729	0.8
607	0.2	669	0.5	730	0.9
608	0.2	670	0.6		
609	0.2	671	0.6		
610	0.2	672	0.7		
611	0.2	673	0.7		
612	0.2	674	0.7		
613	0.2	675	0.7		

Table 2 Pitbladdo Magnetic Susceptability Readings

Depth in cm	Magnetic Susceptability		Depth in cm	Magnetic Susceptability		Depth in cm	Magnetic Susceptability
1	0		62	0		123	0
2	0		63	0		124	0
3	0		64	0		125	0
4	0		65	0		126	0
5	0		66	0		127	0
6	0		67	0		128	0
7	0		68	0		129	0
8	0		69	0		130	0
9	0		70	0		131	0
10	0		71	0		132	0
11	0		72	0		133	0
12	0		73	0		134	0
13	0		74	0		135	0
14	0		75	0		136	0
15	0		76	0		137	0
16	0		77	0		138	0
17	0		78	0		139	0
18	0		79	0		140	0
19	0		80	0		141	0
20	0		81	0		142	0
21	0		82	0		143	0
22	0		83	0		144	0
23	0		84	0		145	0
24	0		85	0		146	0
25	0		86	0		147	0
26	0		87	0		148	0
27	0		88	0		149	0
28	0		89	0		150	0
29	0		90	0		151	0
30	0		91	0		152	0
31	0		92	0		153	0
32	0		93	0		154	0
33	0		94	0		155	0
34	0		95	0		156	0
35	0		96	0		157	0
36	0		97	0		158	0
37	0		98	0		159	0
38	0		99	0		160	0
39	0		100	0		161	0
40	0		101	0		162	0
41	0		102	0		163	0
42	0		103	0		164	0
43	0		104	0		165	0
44	0		105	0		166	0
45	0		106	0		167	0
46	0		107	0		168	0
47	0		108	0		169	0
48	0		109	0		170	0
49	0		110	0		171	0
50	0		111	0		172	0
51	0		112	0		173	0
52	0		113	0		174	0
53	0		114	0		175	0
54	0		115	0		176	0
55	0		116	0		177	0
56	0		117	0		178	0
57	0		118	0		179	0
58	0		119	0		180	0
59	0		120	0		181	0
60	0		121	0		182	0
61	0		122	0		183	0

Table 2 Pitbladdo Magnetic Susceptability Readings

Depth in cm	Magnetic Susceptability	Depth in cm	Magnetic Susceptability	Depth in cm	Magnetic Susceptability
184	0	245	0	308	0
185	0	246	0	309	0
186	0	247	0	310	0
187	0	248	0	311	0
188	0	249	0	312	0
189	0	250	0	313	0
190	0	251	0	314	0
191	0	252	0	315	0
192	0	253	0	316	0
193	0	254	0	317	0
194	0	255	0	318	0
195	0	256	0	319	0
196	0	257	0	320	0
197	0	258	0	321	0
198	0	259	0	322	0
199	0	260	0	323	0
200	0	261	0	324	0
201	0	262	0	325	0
202	0	263	0	326	0
203	0	264	0	327	0
204	0	265	0	328	0
205	0	266	0	329	0
206	0	267	0	330	0
207	0	268	0	331	0
208	0	269	0	332	0
209	0	270	0	333	0
210	0	271	0	334	0
211	0	272	0	335	0
212	0	273	0	336	0
213	0	274	0	337	0
214	0	275	0	338	0
215	0	276	0	339	0
216	0	278	0	340	0
217	0	279	0	341	0
218	0	280	0	342	0
219	0	281	0	344	0
220	0	282	0	345	0
221	0	283	0	346	0
222	0	284	0	347	0
223	0	285	0	348	0
224	0	286	0	349	0
225	0	287	0	350	0
226	0	288	0	351	0
227	0	289	0	352	0
228	0	290	0	353	0
229	0	291	0	354	0
230	0	293	0	355	0
231	0	294	0	356	0
232	0	295	0	357	0
233	0	296	0	358	0
234	0	297	0	359	0
235	0	298	0	360	0
236	0	299	0	361	0
237	0	300	0	362	0
238	0	301	0	363	0
239	0	302	0	364	0
240	0	303	0	365	0
241	0	304	0	366	0
242	0	305	0	367	0
243	0	306	0	368	0
244	0	307	0	369	0

Table 2 Pitbladdo Magnetic Susceptability Readings

Depth in cm	Magnetic Susceptability
370	0
371	0
372	0
373	0
374	0
375	0
376	0
378	0
379	0
380	0
381	0
382	0
383	0
384	0
385	0
386	0
387	0
388	0
389	0
390	0
391	0
392	0
393	0
394	0
395	0
396	0
397	0
398	0
399	0
400	0
401	0
402	0
403	0
404	0
405	0
406	0
407	0
408	0
409	0
410	0
411	0
412	0
413	0
414	0
415	0
416	0
417	0
418	0
419	0
420	0
421	0
422	0
423	0
424	0
425	0
426	0
427	0
428	0
429	0
430	0
431	0
432	0
433	0
434	0
435	0
436	0
437	0
438	0
439	0
440	0
441	0
442	0
443	0
444	0
445	0
446	0
447	0
448	0
449	0
450	0
451	0
452	0
453	0
454	0
455	0
456	0
457	0
458	0
459	0
460	0
461	0
462	0
463	0
464	0
465	0
466	0
467	0
468	0
469	0
470	0.1
471	0.1
472	0.1
473	0.1
474	0.1
475	0.1
476	0.1
477	0.1
478	0.1
479	0.1
480	0.1
481	0.1
482	0.1
483	0.1
484	0.1
485	0.1
486	0.1
487	0.1
488	0.1
489	0.2
490	0.2
491	0.2
492	0.3
493	0.3
494	0.3
495	0.3
496	0.3
497	0.3
498	0.3
499	0.3
500	0.3

Table 3 Methvern Magnetic Susceptability Readings

Depth in cm	Magnetic Susceptability	Depth in cm	Magnetic Susceptability	Depth in cm	Magnetic Susceptability
1	0.1	62	0.1	123	0
2	0	63	0.1	124	0
3	0	64	0.1	125	0
4	0	65	0	126	0
5	0	66	0	127	0
6	0	67	0.1	128	0
7	0	68	0.2	129	0
8	0	69	0.1	130	0
9	0	70	0.1	131	0
10	0	71	0.1	132	0
11	0	72	0.2	133	0
12	0	73	0.1	134	0
13	0	74	0	135	0
14	0	75	0.1	136	0
15	0	76	0.2	137	0
16	0	77	0	138	0
17	0	78	0	139	0
18	0	79	0	140	0
19	0	80	0.1	141	0
20	0	81	0.1	142	0
21	0	82	0	143	0
22	0	83	0	144	0
23	0.1	84	0	145	0
24	0	85	0.1	146	0
25	0	86	0	147	0
26	0.1	87	0	148	0
27	0	88	0	149	0
28	0	89	0	150	0
29	0	90	0	151	0
30	0.1	91	0	152	0
31	0	92	0	153	0
32	0	93	0	154	0
33	0	94	0	155	0
34	0	95	0	156	0.2
35	0	96	0	157	0
36	0	97	0.1	158	0
37	0	98	0	159	0
38	0	99	0	160	0
39	0	100	0	161	0
40	0	101	0.2	162	0
41	0	102	0	163	0
42	0	103	0	164	0
43	0	104	0	165	0
44	0	105	0	166	0
45	0.1	106	0	167	0
46	0	107	0	168	0
47	0	108	0	169	0
48	0	109	0.1	170	0
49	0	110	0	171	0
50	0	111	0	172	0
51	0	112	0	173	0
52	0	113	0	174	0
53	0	114	0	175	0
54	0.1	115	0	176	0
55	0.2	116	0	177	0
56	0.2	117	0.1	178	0
57	0	118	0	179	0
58	0.1	119	0	180	0
59	0	120	0	181	0
60	0.1	121	0	182	0
61	0.3	122	0	183	0

Table 3 Methvern Magnetic Susceptibility Readings

Depth in cm	Magnetic Susceptability		Depth in cm	Magnetic Susceptability		Depth in cm	Magnetic Susceptability
184	0		245	0		308	0
185	0		246	0		309	0
186	0		247	0		310	0
187	0		248	0		311	0
188	0		249	0		312	0
189	0.1		250	0		313	0
190	0		251	0		314	0
191	0		252	0		315	0
192	0		253	0		316	0
193	0		254	0.1		317	0
194	0		255	0		318	0
195	0		256	0		319	0
196	0		257	0.1		320	0
197	0		258	0		321	0
198	0		259	0.1		322	0
199	0		260	0.1		323	0
200	0		261	0		324	0
201	0.1		262	0		325	0
202	0.3		263	0		326	0
203	0		264	0		327	0
204	0		265	0		328	0
205	0		266	0.1		329	0
206	0.1		267	0.1		330	0
207	0		268	0		331	0
208	0.1		269	0		332	0
209	0		270	0.1		333	0
210	0.2		271	0		334	0
211	0		272	0		335	0
212	0		273	0		336	0
213	0		274	0		337	0
214	0		275	0.1		338	0
215	0		276	0		339	0
216	0		278	0.2		340	0
217	0		279	0		341	0
218	0		280	0		342	0
219	0		281	0		344	0
220	0		282	0		345	0
221	0		283	0		346	0
222	0		284	0		347	0
223	0		285	0		348	0
224	0		286	0		349	0
225	0		287	0		350	0
226	0		288	0		351	0.1
227	0		289	0		352	0.1
228	0		290	0		353	0.2
229	0		291	0		354	0.2
230	0		293	0		355	0
231	0		294	0		356	0
232	0		295	0		357	0.1
233	0		296	0		358	0.5
234	0		297	0		359	0.1
235	0		298	0		360	0.1
236	0		299	0		361	0
237	0		300	0		362	0
238	0		301	0		363	0
239	0		302	0		364	0
240	0		303	0		365	0
241	0		304	0		366	0
242	0		305	0		367	0
243	0		306	0		368	0
244	0		307	0		369	0

Table 3 Methvern Magnetic Susceptability Readings

Depth in cm	Magnetic Susceptability		Depth in cm	Magnetic Susceptability		Depth in cm	Magnetic Susceptability
370	0		432	0		493	0
371	0		433	0		494	0
372	0		434	0		495	0
373	0		435	0		496	0
374	0		436	0		497	0
375	0		437	0		498	0
376	0		438	0		499	0
378	0		439	0		500	0
379	0		440	0		501	0
380	0		441	0		502	0
381	0		442	0		503	0.1
382	0		443	0		504	0
383	0		444	0		505	0
384	0		445	0		506	0.2
385	0		446	0		507	0..1
386	0		447	0		508	0.2
387	0		448	0		509	0.1
388	0		449	0		510	0.1
389	0		450	0		511	0
390	0		451	0		512	0
391	0		452	0		513	0.1
392	0		453	0		514	0
393	0		454	0		515	0.1
394	0		455	0		516	0
395	0		456	0		517	0.1
396	0		457	0		518	0
397	0		458	0.1		519	0
398	0		459	0		520	0
399	0		460	0.1		521	0
400	0		461	0		522	0
401	0.3		462	0		523	0
402	0		463	0		524	0
403	0		464	0		525	0
404	0		465	0.1		526	0
405	0		466	0		527	0.1
406	0		467	0.1		528	0.1
407	0		468	0		529	0
408	0		469	0		530	0
409	0		470	0		531	0
410	0		471	0		532	0
411	0		472	0		533	0
412	0		473	0		534	0
413	0		474	0		535	0
414	0		475	0		536	0
415	0		476	0		537	0
416	0		477	0		538	0.1
417	0		478	0		539	0
418	0		479	0		540	0.1
419	0.1		480	0		541	0
420	0		481	0		542	0
421	0		482	0		543	0
422	0		483	0		544	0
423	0		484	0		545	0
424	0		485	0		546	0
425	0		486	0		547	0.1
426	0		487	0		548	0
427	0		488	0		549	0.1
428	0		489	0		550	0
429	0		490	0		551	0.3
430	0		491	0		552	0.2
431	0		492	0		553	0.2

Table 3 Methvern Magnetic Susceptability Readings

Depth in cm	Magnetic Susceptability	Depth in cm	Magnetic Susceptability
554	0.2	615	0
555	0.1	616	0
556	0.1	617	0
557	0.1	618	0
558	0.2	619	0
559	0.1	620	0
560	0.2	621	0.2
561	0.1	622	0.2
562	0.1	623	0.2
563	0	624	0.3
564	0.1	625	0.2
565	0.1	626	0.1
566	0	627	0.2
567	0	628	0.2
568	0.1	629	0.2
569	0.1	630	0.3
570	0.1	631	0.2
571	0.1	632	0.2
572	0	633	0.3
573	0.1	634	0.3
574	0	635	0.2
575	0.1	636	0.7
576	0	637	0.7
577	0	638	0.9
578	0	639	1.1
579	0	640	1.4
580	0	641	1.6
581	0	642	2.1
582	0	643	2.3
583	0	644	2.3
584	0	645	2.7
585	0	646	2.5
586	0	647	2.8
587	0.1	648	2.7
588	0	649	3
589	0	650	3.1
590	0	651	3.1
591	0	652	3.4
592	0	653	3.6
593	0	654	3.4
594	0	655	3.2
595	0.1	656	3.6
596	0	657	4
597	0	658	4.1
598	0.1	659	4.6
599	0	660	4.5
600	0	661	4.3
601	0	662	4.3
602	0		
603	0		
604	0		
605	0		
606	0		
607	0		
608	0		
609	0		
610	0		
611	0		
612	0.1		
613	0		
614	0		

Table 4 Cruvie pH readings

Depth in cm	pH		Depth in cm	pH
1	5.2		256	5.23
8	5.35		264	5.16
16	5.2		272	4.86
24	5.3		280	5.07
32	5.4		288	4.97
40	5.32		296	4.95
48	5.16		304	4.96
56	4.91		312	4.96
64	5.29		320	4.97
72	5.28		328	4.98
80	5.15		336	4.99
88	5.17		344	4.93
96	4.68		352	4.83
104	4.65		360	4.9
112	4.88		368	5.27
120	5.08		376	5.26
128	5.08		384	5.25
136	5.06		392	4.79
144	5.01		400	4.86
152	4.99		408	4.58
160	5.13		416	4.93
168	5.25		424	4.8
176	5.28		432	4.7
184	5.2		440	4.81
192	5.15		448	4.89
200	4.99		456	5.25
208	5.2		464	5.8
216	5.28		472	4.84
224	5.13		480	5.17
232	5.18		488	7.15
240	5.01		496	7.47
248	5.09		504	7.47

Table 5 Pitbladdo pH readings

Depth in cm	pH		Depth in cm	pH
1	5.54		256	5.32
8	5.31		264	5.19
16	5.04		272	4.96
24	5.2		280	4.85
32	5.31		288	4.94
40	4.85		296	4.99
48	5.07		304	5.16
56	5.07		312	4.8
64	5.05		320	4.84
72	5.28		328	4.47
80	5.13		336	5.21
88	5.05		344	5.18
96	4.89		352	4.41
104	5.14		360	4.04
112	5.14		368	4.55
120	4.89		376	4.94
128	5.01		384	4.68
136	4.97		392	4.62
144	5.25		400	5.01
152	5.17		408	5.15
160	5.35		416	5.08
168	5.15		424	4.76
176	5.01		432	4.7
184	4.89		440	4.17
192	4.93		448	4.22
200	5.28		456	4.71
208	5.02		464	4.45
216	5.51		472	4.14
224	5.5		480	3.6
232	5.31		488	3.06
240	5.12		496	6.26
248	5.14			

Table 6 Methvern pH readings

Depth in cm	pH
1	3.83
8	3.84
16	3.97
24	4.03
32	4.06
40	4.09
48	4.09
56	4.09
64	3.96
72	4
80	4.02
88	4.05
96	4.08
104	4.1
112	4.18
120	4.23
128	4.18
136	4.22
144	4.21
152	4.15
160	4.14
168	4.11
176	4.09
184	4.3
192	4.23
200	4.22
208	4.19
216	4.33
224	4.29
232	4.35
240	4.3
248	4.35
256	4.43
264	4.39
272	4.31
280	4.23
288	4.14
296	4.05
304	4.07
312	4.07
320	4.02
328	4.03
336	3.96
344	3.99
352	3.89
360	4
368	3.94
376	4.04
384	4.14
392	3.98
400	4.12
408	4.14
416	4.12
424	4.09
432	4.17
440	4.2
448	4.28
456	3.96
464	3.84
472	3.86
480	4.03
488	4.18
496	4.17
504	4.04
512	4
520	3.8
528	3.97
536	4.06
544	4.55
552	4.55
560	4.54
568	4.5
576	4.49
584	4.61
592	4.53
600	4.45
608	4.45
616	4.06
624	3.81
632	3.65
640	3.61
648	3.98
656	4.17

Table 7 Cruvie loss on ignition readings

Depth in cm	% loss on ignition
4	83
8	86
12	85
16	89
20	86
24	87
28	90
32	86
36	85
40	93
44	92
48	92
52	92
56	93
60	81
64	84
68	94
72	94
76	94
80	94
84	94
88	94
92	92
96	83
100	89
104	91
108	86
112	93
116	91
120	86
124	90
128	93
132	93
136	93
140	93
144	93
148	83
152	89
156	93
160	87
164	87
168	91
172	91
176	89
180	90
184	85
188	83
192	80
196	84
200	87
204	87
208	83
212	80
216	78
220	80
224	84
228	82
232	79
236	83
240	67
244	80
248	87
252	88
256	87
260	84
264	87
268	86
272	87
276	88
280	83
284	84
288	85
292	79
296	83
300	85
304	83
308	83
312	85
316	83
320	86
324	82
328	83
332	82
336	87
340	84
344	86
348	87
352	84
356	85
360	88
364	85
368	80
372	88
376	87
380	84
384	82
388	85
392	79
396	85
400	83
404	86
408	80
412	84
416	81
420	87
424	87
428	88
432	87
436	83
440	51
444	54
448	51
452	51
456	47
460	42
464	34
468	23
472	17
476	12
480	6
484	5
488	6

Table 8 Pitbladdo loss on ignition readings

Depth in cm	% loss on ignition	Depth in cm	% loss on ignition	Depth in cm	% loss on ignition
4	73	196	78	388	80
8	71	200	79	392	78
12	85	204	77	396	79
16	91	208	78	400	81
20	92	212	79	404	81
24	92	216	80	408	81
28	92	220	79	412	81
32	91	224	80	416	81
36	90	228	80	420	81
40	90	232	80	424	82
44	88	236	79	428	80
48	86	240	79	432	81
52	66	244	79	436	80
56	76	248	80	440	78
60	88	252	79	444	78
64	87	256	78	448	78
68	86	260	77	452	77
72	87	264	78	456	79
76	83	268	77	460	78
80	70	272	77	464	78
84	70	276	74	468	78
88	70	280	80	472	73
92	70	284	76	476	71
96	77	288	80	480	65
100	72	292	80	484	6
104	71	296	80	488	3
108	70	300	76		
112	70	304	75		
116	70	308	81		
120	69	312	78		
124	72	316	78		
128	68	320	80		
132	67	324	80		
136	67	328	80		
140	66	332	80		
144	66	336	81		
148	68	340	77		
152	73	344	80		
156	78	348	77		
160	78	352	77		
164	72	356	77		
168	76	360	76		
172	74	364	75		
176	73	368	77		
180	74	372	78		
184	75	376	78		
188	78	380	78		
192	78	384	78		

Table 9 Methvern loss on ignition readings

Depth in cm	% loss on ignition
2	99
6	98
10	98
14	97
18	97
22	97
26	98
30	98
34	97
38	95
42	93
46	92
50	87
54	99
58	99
62	99
66	99
70	99
74	99
78	99
82	99
86	99
90	98
94	99
98	98
102	98
106	99
110	99
114	100
118	100
122	100
126	99
130	98
134	100
138	100
142	100
146	99
150	99
154	99
158	99
162	99
166	99
170	99
174	99
178	100
182	99
186	99
190	99
194	99
198	99
202	99
206	99
210	99
214	98
218	99
222	99
226	99
230	99
234	99
238	99
242	99
246	99
250	99
254	99
258	98
262	98
266	97
270	97
274	97
278	98
282	98
286	98
290	98
294	98
298	98
302	99
306	99
310	98
314	98
318	98
322	98
326	98
330	98
334	98
338	98
342	98
346	98
350	98
354	98
358	98
362	99
366	98
370	99
374	99
378	99
382	97
386	98
390	97
394	97
398	97
402	97
406	97
410	97
414	98
418	98
422	98
426	98
430	98
434	98
438	98
442	98
446	98
450	98
454	99
458	98
462	98
466	98
470	98
474	97
478	96
482	96
486	96
490	96
494	96
498	95
502	95
506	95
510	95
514	95
518	95
522	94
526	95
530	95
534	95
538	95
540	95
544	96
552	95
556	94
560	94
564	94
568	94
572	94
576	94
580	98
584	95
588	95
590	95
592	94
594	94
596	95
598	96
600	96
604	96
608	96
612	95
616	93
620	93
624	92
628	92
632	92
636	39
640	6
644	6

Table 10 showing samples from Cruvie examined for Tephra.

Depth in cm	Presence	Depth in cm	Presence	Depth in cm	Presence	Depth in cm	Presence
0 - 4	x	60 - 64	x	120 - 124	x	184 - 188	x
4 8	x	64 - 68	x	124 - 128	x	188 - 192	x
8 12	x	68 - 72	x	128 - 132	x	192 - 196	x
12 16	x	72 - 76	x	132 - 136	x	196 - 200	x
16 - 20	x	76 - 80	x	136 - 140	x	200 - 204	x
20 - 24	x	80 - 84	x	140 - 144	x	204 - 208	x
24 - 28	x	84 - 88	x	144 - 148	x	208 - 212	x
28 - 32	x	88 - 92	x	148 - 152	x	212 - 216	x
32 - 36	x	92 - 96	x	152 - 156	x	216 - 220	x
36 - 40	x	96 - 100	x	156 - 160	x	220 - 224	x
40 - 44	x	100 - 104	x	160 - 164	x	224 - 228	x
44 - 48	x	104 - 108	x	164 - 168	x	228 - 232	x
48 - 52	x	108 - 112	x	168 - 172	x	232 - 236	x
52 - 56	x	112 - 116	x	172 - 176	x	236 - 240	x
56 - 60	x	116 - 120	x	176 - 180	x	240 -244	x
				180 - 184	x	244 - 248	x

Key

x = Tephra absent.

Table 11 showing samples from Pitbladdo examined for Tephra.

Depth in cm	Presence	Depth in cm	Presence	Depth in cm	Presence	Depth in cm	Presence
0 - 4	x	60 - 64	x	120 - 124	x	184 - 188	x
4 8	x	64 - 68	x	124 - 128	x	188 - 192	x
8 12	x	68 - 72	x	128 - 132	x	192 - 196	x
12 16	x	72 - 76	x	132 - 136	x	196 - 200	x
16 - 20	x	76 - 80	x	136 - 140	x	200 - 204	x
20 - 24	x	80 - 84	x	140 - 144	x	204 - 208	x
24 - 28	x	84 - 88	x	144 - 148	x	208 - 212	x
28 - 32	x	88 - 92	x	148 - 152	x	212 - 216	x
32 - 36	x	92 - 96	x	152 - 156	x	216 - 220	x
36 - 40	x	96 - 100	x	156 - 160	x	220 - 224	x
40 - 44	x	100 - 104	x	160 - 164	x	224 - 228	x
44 - 48	x	104 - 108	x	164 - 168	x	228 - 232	x
48 - 52	x	108 - 112	x	168 - 172	x	232 - 236	x
52 - 56	x	112 - 116	x	172 - 176	x	236 - 240	x
56 - 60	x	116 - 120	x	176 - 180	x	240 -244	x
				180 - 184	x	244 - 248	x

Key

x = Tephra absent.

Table 12 showing samples from Methvern examined for Tephra.

Depth in cm	Presence	Depth in cm	Presence	Depth in cm	Presence	Depth in cm	Presence
44 - 48	x	156 - 160	x	268 - 272	x	380 - 384	x
48 - 52	x	160 - 164	x	272 - 276	x	384 - 388	x
52 - 56	x	164 - 168	x	276 - 280	x	388 - 392	x
56 - 60	x	168 - 172	x	280 - 284	x	392 - 396	x
60 - 64	x	172 - 176	x	284 - 288	x	396 - 400	x
64 - 68	x	176 - 180	x	288 - 292	x	400 - 404	x
68 - 72	x	180 - 184	x	292 - 296	x	404 - 408	x
72 - 76	x	184 - 188	x	296 - 300	x	408 - 412	x
76 - 80	x	188 - 192	x	300 - 304	x	412 - 416	x
80 - 84	x	192 - 196	x	304 - 308	x	416 - 420	x
84 - 88	x	196 - 200	x	308 - 312	x		
88 - 92	x	200 - 204	x	312 - 316	x		
92 - 96	x	204 - 208	x	316 - 320	x		
96 - 100	x	208 - 212	x	320 - 324	x		
100 - 104	x	212 - 216	x	324 - 328	x		
104 - 108	x	216 - 220	x	328 - 332	x		
108 - 112	x	220 - 224	x	332 - 336	x		
112 - 116	x	224 - 228	x	336 - 340	x		
116 - 120	x	228 - 232	x	340 - 344	x		
120 - 124	x	232 - 236	x	344 - 348	x		
124 - 128	x	236 - 240	x	348 - 352	x		
128 - 132	x	240 - 244	x	352 - 356	x		
132 - 136	x	244 - 248	x	356 - 360	x		
136 - 140	x	248 - 252	x	360 - 364	x		
140 - 144	x	252 - 256	x	364 - 368	x		
144 - 148	x	256 - 260	x	368 - 372	x		
148 - 152	x	260 - 264	x	372 - 376	x		
152 - 156	x	264 - 268	x	376 - 380	x		

Key

x = Tephra absent.

Table 13 showing x - radiography undertaken on sediments from Cruvie

Depth	Section	x - rayed
0 - 1 m	x	No
	Top	Yes
1 - 2 m	Middle	Yes
	Bottom	Yes
	Top	Yes
2 - 3 m	Middle	Yes
	Bottom	Yes
	Top	Yes
3 - 4 m	Middle	Yes
	Bottom	Yes
	Top	Yes
4 - 5 m	Middle	Yes
	Bottom	Yes
	Top	Yes
5 - 6 m	Middle	Yes
	Bottom	Yes
	Top	Yes
6 - 7 m	Middle	Yes
	Bottom	Yes
7 - 7.5 m	x	No

Cruvie Count Data.

Table 1 Cruvie 10cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	2	0	0	0	0	**2**
Betula	13	1	1	2	0	**17**
Alnus	60	27	23	1	0	**111**
Quercus	9	0	0	0	0	**9**
Ulmus	6	6	0	0	0	**12**
Coryloid	19	15	1	2	0	**37**
Gramineae	26	1	0	12	3	**42**
Cyperaceae	3	0	0	0	0	**3**
Filipendula	2	0	0	0	0	**2**
Rumex acetosa / sella	4	3	0	0	0	**7**
Plantago lanceolata	1	0	0	0	0	**1**
Plantago media / major	1	1	0	0	0	**2**
Artemisia	1	0	0	0	0	**1**
Polypodium undiff.	4	0	0	0	0	**4**
Filicales undiff.	41	3	0	2	10	**56**
Total	**192**	**57**	**25**	**19**	**13**	**306**
Indeterminate	C3	29	0	1	0	**33**
Lycopodium clavatum						**102**

Table 2 Cruvie 26cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	0	0	**1**
Betula	16	2	0	0	0	**18**
Alnus	178	12	1	0	1	**192**
Quercus	6	0	0	0	0	**6**
Ulmus	8	0	0	0	0	**8**
Coryloid	70	3	0	0	0	**73**
Gramineae	8	1	0	4	3	**16**
Umbelliferae	1	0	0	0	0	**1**
Rumex acetosa / sella	9	0	0	0	0	**9**
Polypodium undiff.	4	0	0	0	0	**4**
Filicales undiff.	2	0	0	0	2	**4**
Athyrium filax-femina	3	0	0	0	0	**3**
Dryopteris undiff.	3	0	0	0	0	**3**
Total	**309**	**18**	**1**	**4**	**6**	**338**
Callitriche	2	0	0	0	0	**2**
Typha latifolia	1	0	0	0	0	**1**
Indeterminate	C4	3	0	0	0	**7**
Lycopodium clavatum						**157**

Table 3 Cruvie 40cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	1	0	0	**2**
Betula	7	0	0	0	0	**7**
Alnus	272	0	0	0	0	**272**
Quercus	2	0	0	0	0	**2**
Ulmus	19	1	0	0	0	**20**
Coryloid	131	1	0	1	0	**133**
Ericaceae	1	0	0	0	0	**1**
Gramineae	21	0	0	4	0	**25**
Cyperaceae	8	1	0	0	0	**9**
Caryophyllaceae	1	0	0	0	0	**1**
Chenopodiaceae	2	0	0	0	0	**2**
Rumex acetosa / sella	18	0	0	0	0	**18**
Plantago media / major	2	0	0	0	0	**2**
Aster type	2	0	0	0	0	**2**
Polypodium undiff.	7	0	0	0	0	**7**
Filicales undiff.	4	0	0	0	0	**4**
Dryopteris undiff.	1	0	0	0	0	**1**
Total	**499**	**3**	**1**	**5**	**0**	**508**
Indeterminate	C3	2	0	1	0	**6**
Lycopodium clavatum						**171**
Carbon frags.						**4**

Table 4 Cruvie 56cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	0	0	**1**
Betula	9	0	0	0	0	**9**
Alnus	149	2	3	0	3	**157**
Quercus	5	0	0	0	0	**5**
Ulmus	19	0	0	0	0	**19**
Coryloid	74	1	0	2	0	**77**
Gramineae	1	0	0	0	0	**1**
Cyperaceae	2	0	0	0	0	**2**
Ranunculus type	2	0	0	0	0	**2**
Chenopodiaceae	2	0	0	0	0	**2**
Rumex acetosa / sella	20	0	0	0	0	**20**
Campanulaceae	1	0	0	0	0	**1**
Artemisia	1	0	0	0	0	**1**
Polypodium undiff.	5	0	0	0	0	**5**
Filicales undiff.	1	0	0	0	0	**1**
Dryopteris undiff.	1	0	0	0	0	**1**
Total	**293**	**3**	**3**	**2**	**3**	**304**
Potamogeton	1	0	0	0	0	**1**
Indeterminate	C3	3	0	1	1	**8**
Lycopodium clavatum						**145**
Carbon frags.						**3**

Table 5 Cruvie 72cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Betula	17	1	0	0	0	**18**
Alnus	143	11	2	0	0	**156**
Quercus	2	0	0	0	0	**2**
Ulmus	15	0	0	0	0	**15**
Salix	1	0	0	0	0	**1**
Coryloid	59	4	0	0	0	**63**
Gramineae	7	0	0	0	0	**7**
Cyperaceae	6	0	0	0	0	**6**
Ranunculus type	2	0	0	0	0	**2**
Filipendula	7	0	0	0	0	**7**
Rumex acetosa / sella	16	0	0	0	0	**16**
Polypodium undiff.	2	0	0	0	0	**2**
Filicales undiff.	5	1	0	0	0	**6**
Dryopteris undiff.	4	0	0	0	0	**4**
Total	**286**	**17**	**2**	**0**	**0**	**305**
Nymphaea	4	0	0	0	0	**4**
Indeterminate	C4	0	0	0	0	**4**
Lycopodium clavatum						**121**
Carbon frags.						**2**

Table 6 Cruvie 88cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Betula	20	1	0	1	0	**21**
Alnus	124	14	2	0	0	**150**
Ulmus	10	0	0	0	0	**10**
Coryloid	46	2	0	0	0	**48**
Gramineae	15	0	0	0	0	**15**
Cyperaceae	15	0	0	2	0	**17**
Ranunculus type	5	0	0	0	0	**5**
Rumex acetosa / sella	20	0	0	0	0	**20**
Plantago media / major	5	0	0	0	0	**5**
Polypodium undiff.	5	0	0	0	0	**5**
Pteridium	1	0	0	0	0	**1**
Filicales undiff.	2	0	0	0	0	**2**
Dryopteris undiff.	5	0	0	0	0	**5**
Total	**273**	**17**	**2**	**3**	**0**	**304**
Nymphaea	11	0	0	0	0	**11**
Indeterminate	C7	0	0	0	0	**7**
Lycopodium clavatum						**173**
Carbon frags.						**4**

Table 7 Cruvie 104cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	2	0	0	0	0	**2**
Betula	8	0	0	0	0	**8**
Alnus	82	4	0	0	0	**86**
Ulmus	44	0	0	2	0	**46**
Salix	2	0	0	0	0	**2**
Coryloid	64	1	0	0	0	**64**
Ericaceae	8	0	0	0	0	**8**
Gramineae	39	0	1	5	2	**47**
Cyperaceae	16	0	0	0	0	**16**
Umbelliferae	1	0	0	0	0	**1**
Rumex acetosa / sella	16	0	0	0	0	**16**
Polypodium undiff.	7	0	0	0	0	**7**
Filicales undiff.	6	0	0	0	0	**6**
Total	**295**	**5**	**1**	**7**	**2**	**309**
Nymphaea	1	0	0	0	0	**1**
Myriophyllum sp	2	0	0	0	0	**2**
Sparganium	0	1	0	0	0	**1**
Indeterminate	C5	0	0	3	0	**8**
Lycopodium clavatum						**151**
Carbon frags.						**2**

Table 8 Cruvie 120cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	0	1	**2**
Betula	23	0	0	0	0	**23**
Alnus	141	4	0	0	1	**146**
Quercus	6	0	0	0	0	**6**
Ulmus	7	0	0	0	0	**7**
Coryloid	75	4	0	0	0	**79**
Gramineae	15	0	0	0	0	**15**
Cyperaceae	2	0	0	0	0	**2**
Ranunculus type	1	0	0	0	0	**1**
Rumex acetosa / sella	10	0	0	0	0	**10**
Polypodium undiff.	5	0	0	0	0	**5**
Filicales undiff.	2	0	0	0	0	**2**
Dryopteris undiff.	2	0	0	0	0	**2**
Total	**290**	**8**	**0**	**0**	**2**	**300**
Nymphaea	1	0	0	0	0	**1**
Myriophyllum sp	1	0	0	0	0	**1**
Callitriche	6	0	0	0	0	**6**
Potamogeton	2	0	0	0	0	**2**
Indeterminate	C4	0	0	2	1	**7**
Lycopodium clavatum						**64**
Carbon frags.						**3**

Table 9 Cruvie 136cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	3	0	0	0	1	**4**
Betula	72	5	0	1	2	**80**
Alnus	30	0	0	0	0	**30**
Quercus	5	0	0	0	0	**5**
Ulmus	11	0	0	0	0	**11**
Coryloid	111	9	0	1	1	**122**
Gramineae	1	0	0	1	1	**3**
Cyperaceae	9	0	0	0	0	**9**
Chenopodiaceae	1	0	0	0	0	**1**
Filipendula	2	0	0	0	0	**2**
Rumex acetosa / sella	22	1	0	0	0	**23**
Aster type	3	0	0	0	0	**3**
Artemisia	1	0	0	0	0	**1**
Polypodium undiff.	3	0	0	0	0	**3**
Filicales undiff.	4	0	0	0	1	**5**
Dryopteris undiff.	3	0	0	0	0	**3**
Total	**281**	**15**	**0**	**3**	**6**	**305**
Nymphaea	2	0	0	0	0	**2**
Callitriche	12	0	0	0	0	**12**
Potamogeton	3	0	0	0	0	**3**
Indeterminate	C3	7	1	2	1	**14**
Lycopodium clavatum						**47**
Carbon frags.						**3**

Table 10 Cruvie 152cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	1	3	**5**
Betula	43	5	0	0	2	**50**
Alnus	7	0	0	0	0	**7**
Quercus	11	1	0	0	0	**12**
Ulmus	15	1	0	1	0	**17**
Coryloid	120	27	0	2	5	**154**
Gramineae	4	0	0	0	2	**6**
Cyperaceae	12	0	0	1	1	**14**
Chenopodiaceae	1	0	0	0	0	**1**
Filipendula	2	0	0	0	0	**2**
Rumex acetosa / sella	15	2	0	0	0	**17**
Plantago media / major	1	0	0	0	0	**1**
Aster type	2	0	0	0	0	**2**
Artemisia	1	0	0	0	0	**1**
Polypodium undiff.	1	0	0	0	0	**1**
Filicales undiff.	3	0	0	0	9	**12**
Dryopteris undiff.	2	0	0	0	0	**2**
Total	**241**	**36**	**0**	**5**	**22**	**304**
Nymphaea	2	0	0	0	0	**2**
Callitriche	3	0	0	0	0	**3**
Indeterminate	C3	9	0	0	0	**12**
Lycopodium clavatum						**41**
Carbon frags.						**2**

Table 11 Cruvie 168cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	5	2	0	2	8	**17**
Betula	79	1	0	2	5	**87**
Alnus	5	0	0	0	0	**5**
Quercus	4	0	0	0	0	**4**
Ulmus	15	0	0	0	0	**15**
Coryloid	103	13	0	0	4	**120**
Gramineae	6	1	0	2	0	**9**
Cyperaceae	7	0	0	0	0	**7**
Filipendula	5	0	0	0	0	**5**
Rumex acetosa / sella	19	0	0	0	0	**19**
Aster type	3	0	0	0	0	**3**
Artemisia	3	0	0	0	0	**3**
Filicales undiff.	3	0	0	0	4	**7**
Dryopteris undiff.	1	0	0	0	0	**1**
Total	**258**	**17**	**0**	**6**	**21**	**302**
Nymphaea	4	0	0	0	0	**4**
Callitriche	1	0	0	0	0	**1**
Indeterminate	0	7	0	1	0	**8**
Lycopodium clavatum						**72**
Carbon frags.						**1**

Table 12 Cruvie 184cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	9	0	1	0	6	**16**
Betula	77	5	0	0	0	**82**
Alnus	12	2	0	0	0	**14**
Quercus	6	0	0	0	0	**6**
Ulmus	14	1	0	0	0	**15**
Salix	1	0	0	0	0	**1**
Coryloid	128	5	0	0	0	**133**
Ericaceae	1	0	0	0	0	**1**
Gramineae	7	0	0	0	0	**7**
Cyperaceae	16	0	0	0	0	**16**
Rumex acetosa / sella	21	1	0	0	0	**22**
Plantago media / major	1	0	0	0	0	**1**
Aster type	2	0	0	0	0	**2**
Artemisia	5	0	0	0	0	**5**
Polypodium undiff.	1	0	0	0	0	**1**
Filicales undiff.	4	0	0	1	0	**5**
Total	**305**	**14**	**1**	**1**	**6**	**327**
Nymphaea	8	0	0	0	0	**8**
Potamogeton	1	0	0	0	0	**1**
Typha latifolia	1	0	0	0	0	**1**
Indeterminate	C5	0	0	2	0	**7**
Lycopodium clavatum						**111**

Table 13 Cruvie 200cm.						
Taxa	Normal	Corroded	Degraded	Crumpled	Split	Total
Pinus	1	1	0	0	1	**3**
Betula	63	5	0	0	0	**68**
Quercus	3	0	0	0	0	**3**
Ulmus	9	0	0	0	0	**9**
Salix	1	0	. 0	0	0	**1**
Coryloid	141	7	0	0	0	**148**
Ericaceae	1	0	0	0	0	**1**
Gramineae	7	1	0	0	0	**8**
Cyperaceae	27	0	0	0	0	**27**
Ranunculus type	1	0	0	0	0	**1**
Filipendula	1	0	0	0	0	**1**
Rumex acetosa / sella	20	0	0	0	0	**20**
Plantago media/major	1	0	0	0	0	**1**
Aster type	2	0	0	0	0	**2**
Artemisia	6	0	0	0	0	**6**
Polypodium undiff.	1	0	0	0	0	**1**
Filicales undiff.	4	1	0	0	1	**6**
Total	**289**	**15**	**0**	**0**	**2**	**306**
Nymphaea	5	0	0	0	0	5
Indeterminate	0	9	0	0	0	9
Lycopodium clavatum						84
Carbon frags.						3

Table 14 Cruvie 216cm.						
Taxa	Normal	Corroded	Degraded	Crumpled	Split	Total
Pinus	9	1	0	1	0	**11**
Betula	61	0	0	0	2	**63**
Quercus	6	0	0	0	0	**6**
Ulmus	34	0	0	0	0	**34**
Coryloid	80	3	0	1	1	**86**
Gramineae	9	0	0	2	0	**11**
Cyperaceae	10	1	0	8	0	**19**
Ranunculus type	6	0	0	0	0	**6**
Filipendula	1	0	0	0	0	**1**
Rumex acetosa / sella	34	0	0	0	0	**34**
Aster type	2	0	0	0	0	**2**
Artemisia	3	1	0	0	0	**4**
Polypodium undiff.	1	0	0	0	1	
Filicales undiff.	17	0	0	1	8	**26**
Total	**273**	**6**	**0**	**13**	**12**	**303**
Nymphaea	16	0	0	0	1	**17**
Myriophyllum spicatum	1	0	0	0	0	**1**
Indeterminate	C4	5	0	0	0	9
Lycopodium clavatum						136
Carbon frags.						3

Table 15 Cruvie 232cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	16	2	1	2	9	**30**
Betula	75	1	0	1	1	**78**
Alnus	3	0	0	0	0	**3**
Quercus	6	0	0	0	0	**6**
Ulmus	39	0	0	1	0	**40**
Salix	3	0	0	0	0	**3**
Coryloid	77	1	0	1	0	**79**
Hedera helix	2	0	0	0	0	**2**
Gramineae	14	0	0	7	0	**21**
Cyperaceae	19	0	0	2	0	**21**
Ranunculus type	3	0	0	0	0	**3**
Filipendula	1	0	0	0	0	**1**
Rumex acetosa / sella	16	0	0	0	0	**16**
Aster type	5	0	0	0	0	**5**
Artemisia	1	0	0	0	0	**1**
Polypodium undiff.	1	0	0	0	0	**1**
Filicales undiff.	14	3	0	0	3	**20**
Dryopteris undiff.	1	0	0	0	0	**1**
Total	**296**	**7**	**1**	**14**	**13**	**331**
Indeterminate	C2	1	0	4	2	**9**
Sphagnum						**1**
Lycopodium clavatum						**85**
Carbon frags.						**5**

Table 16 Cruvie 248cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	10	4	0	2	9	**25**
Betula	75	5	0	0	1	**81**
Alnus	1	0	0	0	0	**1**
Quercus	2	0	0	0	0	**2**
Ulmus	21	0	0	0	0	**21**
Salix	2	0	0	0	0	**2**
Coryloid	72	6	0	1	0	**79**
Hedera helix	3	0	0	0	0	**3**
Gramineae	22	1	0	0	0	**23**
Cyperaceae	23	4	0	0	0	**27**
Ranunculus type	1	0	0	0	0	**1**
Caryophyllaceae	1	0	0	0	0	**1**
Filipendula	2	0	0	0	0	**2**
Rumex acetosa / sella	3	0	0	0	0	**3**
Aster type	5	0	0	0	0	**5**
Polypodium undiff.	2	0	0	0	0	**2**
Filicales undiff.	10	9	0	0	4	**23**
Total	**255**	**29**	**0**	**3**	**14**	**301**
Indeterminate	C3	0	0	0	0	**3**
Lycopodium clavatum						**183**
Carbon frags.						**8**

Table 17 Cruvie 264cm.

Taxa	Normal	Corroded	Degraded	Crumpled	Split	Total
Pinus	6	0	0	1	2	**9**
Betula	62	2	0	3	9	**76**
Ulmus	21	1	0	0	0	**22**
Salix	1	0	0	0	0	**1**
Coryloid	81	1	0	8	0	**90**
Gramineae	22	1	0	47	8	**78**
Cyperaceae	10	0	0	1	1	**12**
Aster type	2	0	0	0	0	**2**
Artemisia	2	2	0	0	0	**4**
Polypodium undiff.	2	0	0	0	0	**2**
Filicales undiff.	2	0	0	0	3	**5**
Total	**211**	**7**	**0**	**60**	**23**	**301**
Indeterminate	C1	2	0	0	1	**4**
Lycopodium clavatum						**137**
Carbon						**2**

Table 18 Cruvie 280cm.

Taxa	Normal	Corroded	Degraded	Crumpled	Split	Total
Pinus	2	0	0	1	4	**7**
Betula	61	3	0	1	4	**69**
Ulmus	16	1	0	1	0	**18**
Salix	1	0	0	0	0	**1**
Coryloid	123	11	0	6	2	**142**
Ericaceae	2	0	0	0	0	**2**
Gramineae	22	1	0	50	0	**73**
Cyperaceae	5	0	0	0	0	**5**
Chenopodiaceae	1	0	0	0	0	**1**
Filipendula	1	0	0	0	0	**1**
Aster type	4	0	0	0	0	**4**
Artemisia	2	0	0	0	0	**2**
Filicales undiff.	2	0	0	0	1	**3**
Total	**242**	**16**	**0**	**59**	**11**	**328**
Typha latifolia	1	0	0	0	0	**1**
Indeterminate	0	1	0	0	0	**1**
Lycopodium clavatum						**59**
Carbon frags.						**5**

Table 19 Cruvie 296cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	3	0	0	0	3	**6**
Betula	47	4	0	1	2	**54**
Quercus	2	0	0	0	0	**2**
Ulmus	6	0	0	0	0	**6**
Salix	3	0	0	0	0	**3**
Coryloid	49	6	0	8	4	**167**
Ericaceae	1	0	0	0	0	**1**
Gramineae	1	0	0	33	6	**40**
Rumex acetosa / sella	3	0	0	0	0	**3**
Plantago media / major	4	0	0	0	0	**4**
Aster type	6	0	0	0	0	**6**
Artemisia	2	0	0	0	0	**2**
Filicales undiff.	3	1	0	0	6	**10**
Total	**130**	**11**	**0**	**42**	**21**	**304**
Nuphar	1	0	0	0	0	**1**
Callitriche	1	0	0	0	0	**1**
Indeterminate	C3	3	0	2	2	**10**
Lycopodium clavatum						**105**
Carbon frags.						**4**

Table 20 Cruvie 312cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	4	0	0	0	6	**10**
Betula	28	1	0	7	3	**39**
Quercus	2	0	0	0	0	**2**
Coryloid	150	4	0	10	2	**166**
Ericaceae	2	0	0	0	0	**2**
Gramineae	6	31	0	0	6	**43**
Cyperaceae	5	0	0	0	2	**7**
Rumex acetosa / sella	1	0	0	0	0	**1**
Plantago media / major	1	0	0	0	0	**1**
Aster type	5	0	0	0	0	**5**
Artemisia	1	0	0	0	0	**1**
Filicales undiff.	6	1	0	0	1	**23**
Total	**211**	**37**	**0**	**17**	**20**	**300**
Typha latifolia	1	0	0	0	0	**1**
Indeterminate	C7	0	0	1	1	**9**
Lycopodium clavatum						**158**
Carbon frags.						**3**

Table 21 Cruvie 328cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	0	0	0	0	5	**5**
Betula	35	1	0	3	0	**39**
Quercus	1	0	0	0	0	**1**
Salix	8	0	0	0	0	**8**
Coryloid	198	11	0	9	4	**222**
Gramineae	5	0	0	12	2	**19**
Cyperaceae	1	0	0	1	0	**2**
Chenopodiaceae	1	0	0	0	0	**1**
Filipendula	3	0	0	0	0	**3**
Rumex acetosa / sella	1	0	0	0	0	**1**
Plantago media / major	2	0	0	0	0	**2**
Aster type	1	0	0	0	0	**1**
Filicales undiff.	3	0	0	1	4	**8**
Dryopteris undiff.	2	0	0	0	0	**2**
Total	**261**	**12**	**0**	**26**	**15**	**314**
Indeterminate	C4	1	0	3	1	**9**
Lycopodium clavatum						**64**

Table 22 Cruvie 344cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	4	0	0	0	1	**5**
Betula	41	1	1	5	2	**50**
Salix	2	0	0	0	0	**2**
Coryloid	190	9	2	6	1	**208**
Gramineae	9	0	0	6	2	**17**
Cyperaceae	4	0	0	1	0	**5**
Ranunculus type	1	0	0	0	0	**1**
Chenopodiaceae	1	0	0	0	0	**1**
Filipendula	2	0	0	0	0	**2**
Rumex acetosa / sella	2	0	0	0	0	**2**
Artemisia	1	0	0	0	0	**1**
Filicales undiff.	5	1	0	0	2	**8**
Dryopteris undiff.	1	0	0	0	0	**1**
Total	**263**	**11**	**3**	**18**	**8**	**303**
Nuphar	1	0	0	0	0	**1**
Callitriche	1	0	0	0	0	**1**
Indeterminate	C3	7	0	0	0	**10**
Lycopodium clavatum						**73**
Carbon frags.						**3**

Table 23 Cruvie 360cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	3	0	0	0	1	**4**
Betula	19	1	0	3	0	**22**
Salix	15	0	0	0	0	**15**
Coryloid	214	8	1	13	1	**237**
Gramineae	13	0	0	5	0	**18**
Cyperaceae	8	0	0	0	0	**8**
Filipendula	2	0	0	0	0	**2**
Umbelliferae	1	0	0	0	0	**1**
Rumex acetosa / sella	2	0	0	0	0	**2**
Filicales undiff.	4	0	0	0	0	**4**
Total	**281**	**9**	**1**	**21**	**2**	**313**
Indeterminate	0	0	0	1	0	**1**
Lycopodium clavatum						**75**
Carbon						**1**

Table 24 Cruvie 376cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	12	0	0	1	8	**21**
Betula	43	0	0	1	1	**45**
Quercus	4	0	0	0	0	**4**
Ulmus	1	0	0	0	0	**1**
Salix	6	0	0	0	0	**6**
Coryloid	72	0	0	0	0	**72**
Ericaceae	4	0	0	0	0	**4**
Gramineae	91	0	0	1	0	**92**
Cyperaceae	21	0	0	0	0	**21**
Ranunuculus type	1	0	0	0	0	**1**
Chenopodiaceae	1	0	0	0	0	**1**
Filipendula	5	0	0	0	0	**5**
Artemisia	2	0	0	0	0	**2**
Filicales undiff.	16	1	0	0	6	**23**
Dryopteris undiff.	2	0	0	0	0	**2**
Total	**281**	**1**	**0**	**3**	**15**	**300**
Typha latifolia	4	0	0	0	0	**4**
Indeterminate	9	0	0	0	0	**9**
Sphagnum						**2**
Lycopodium clavatum						**262**
Carbon frags.						**6**

Table 25 Cruvie 392cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	9	0	0	1	7	**17**
Betula	123	3	0	11	15	**152**
Salix	11	0	0	0	0	**11**
Coryloid	41	1	0	1	0	**43**
Gramineae	22	0	0	21	3	**46**
Cyperaceae	6	0	0	0	0	**6**
Filipendula	1	0	0	0	0	**1**
Epilobium	0	0	0	0	1	**1**
Rumex acetosa / sella	1	0	0	0	0	**1**
Plantago media/major	1	0	0	0	0	**1**
Filicales undiff.	11	1	0	1	19	**32**
Total	**226**	**5**	**0**	**35**	**45**	**311**
Indeterminate	C2	0	0	0	2	**4**
Lycopodium clavatum						**162**
Carbon frags.						**13**

Table 26 Cruvie 408cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	5	0	0	1	5	**11**
Betula	46	1	0	7	4	**58**
Salix	4	0	0	0	0	**4**
Coryloid	11	0	0	0	0	**11**
Ericaceae	7	0	0	0	0	**7**
Gramineae	46	2	0	59	2	**109**
Cyperaceae	8	0	0	0	0	**8**
Filipendula	2	0	0	0	0	**2**
Rumex acetosa / sella	3	0	0	0	0	**3**
Plantago media / major	2	0	0	0	0	**2**
Taraxacum	1	0	0	0	0	**1**
Aster type	1	0	0	0	0	**1**
Polypodium undiff.	4	0	0	0	0	**4**
Filicales undiff.	31	2	0	0	44	**77**
Dryopteris undiff.	10	0	0	0	4	**14**
Total	**181**	**5**	**0**	**67**	**59**	**312**
Typha latifolia	4	0	0	0	0	**4**
Indeterminate	C1	0	0	0	1	**2**
Lycopodium clavatum						**69**
Carbon frags.						**15**

Table 27 Cruvie 424cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	11	0	0	1	1	**13**
Betula	38	2	0	3	0	**43**
Salix	1	0	0	0	0	**1**
Ericaceae	43	0	0	0	0	**43**
Gramineae	76	1	0	35	0	**112**
Cyperaceae	16	0	0	0	0	**16**
Caryophyllaceae	1	0	0	0	0	**1**
Filipendula	12	0	0	0	0	**12**
Epilobium	5	0	0	0	0	**5**
Umbelliferae	1	0	0	0	0	**1**
Plantago media / major	2	0	0	0	0	**2**
Compositae lig.	3	0	0	0	0	**3**
Taraxacum	1	0	0	0	0	**1**
Filicales undiff.	39	0	0	0	12	**51**
Total	**249**	**3**	**0**	**39**	**13**	**304**
Typha latifolia	22	0	0	0	0	**22**
Indeterminate	C2	0	0	0	0	**2**
Lycopodium clavatum						**121**
Carbon frags.						**34**

Table 28 Cruvie 440cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	14	0	0	0	2	**16**
Gramineae	1	0	0	0	0	**1**
Cyperaceae	1	0	0	0	0	**1**
Caryophyllaceae	4	0	0	0	0	**4**
Epilobium	0	0	0	0	1	**1**
Total	**20**	**0**	**0**	**0**	**3**	**23**
Sphagnum						**6**
Lycopodium clavatum						**517**
Carbon frags.						**51**

Table 29 Cruvie 456cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	17	2	0	6	9	**34**
Juniperus communis	1	0	0	0	0	**1**
Gramineae	3	0	0	0	0	**3**
Total	**21**	**2**	**0**	**6**	**9**	**38**
Lycopodium clavatum						**500**
Carbon frags.						**42**

Table 30 Cruvie 472cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	7	0	0	11	16	**34**
Juniperus communis	1	0	0	0	0	**1**
Gramineae	0	0	0	7	0	**7**
Total	**8**	**0**	**0**	**18**	**16**	**42**
Lycopodium clavatum						**560**
Carbon frags.						**78**

Table 31 Cruvie 488cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	27	4	0	3	15	**49**
Juniperus communis	1	0	0	0	0	**1**
Gramineae	2	0	0	2	0	**4**
Filicales undiff.	1	0	0	0	0	**1**
Total	**31**	**4**	**0**	**5**	**15**	**55**
Lycopodium clavatum						**354**
Carbon frags.						**168**

Pitbladdo Count Data

Table 1 Pitbladdo 1cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	10	0	0	1	3	**14**
Betula	4	0	0	0	0	**4**
Alnus	6	0	0	0	0	**6**
Coryloid	8	0	0	0	0	**8**
Ericaceae	3	0	0	0	0	**3**
Gramineae	139	2	0	92	2	**235**
Cereal type	0	0	0	1	0	**1**
Cyperaceae	2	0	0	20	0	**22**
Ranunculus type	1	0	0	0	0	**1**
Sinapis	1	0	0	0	0	**1**
Caryophyllaceae	2	0	0	0	0	**2**
Chenopodiaceae	1	0	0	0	0	**1**
Filipendula	2	0	0	0	0	**2**
Plantago lanceolata	6	0	0	0	0	**6**
Compositae lig.	3	0	0	0	0	**3**
Ambrosia	1	0	1	0	0	**2**
Pteridium	5	0	0	0	1	**6**
Filicales undiff.	6	0	0	0	1	**7**
Total	**200**	**2**	**1**	**114**	**7**	**324**
Sphagnum	2	0	0	0	0	**2**
Indeterminate	C1	0	0	0	0	**1**
Lycopodium clavatum						**55**
Carbon frags.						**33**

Table 2 Pitbladdo 8cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	6	0	0	0	3	**9**
Betula	5	0	0	0	0	**5**
Alnus	7	0	0	0	0	**7**
Quercus	2	0	0	0	0	**2**
Ulmus	2	0	0	0	0	**2**
Salix	1	0	0	0	0	**1**
Coryloid	5	1	0	0	0	**6**
Hedera helix	1	0	0	0	0	**1**
Empetraceae	1	0	0	0	0	**1**
Ericaceae	5	0	0	0	0	**5**
Gramineae	48	1	0	117	0	**166**
Cyperaceae	3	0	0	38	2	**43**
Hypercium pulchrum	1	0	0	0	0	**1**
Caryophyllaceae	3	0	0	0	0	**3**
Chenopodiaceae	1	0	0	0	0	**1**
Filipendula	7	0	0	0	0	**7**
Plantago lanceolata	2	0	0	0	0	**2**
Compositae tub.	1	0	0	0	0	**1**
Taraxacum	3	0	0	0	0	**3**
Polypodium undiff.	1	0	0	0	0	**1**
Pteridium	3	0	0	1	0	**4**
Filicales undiff.	17	1	0	1	11	**30**
Total	**125**	**3**	**0**	**157**	**16**	**301**
Sphagnum	8	0	0	1	0	**9**
Typha latifolia	5	0	0	0	0	**5**
Indeterminate	C3	1	0	7	3	**14**
Lycopodium clavatum						**63**
Carbon frags.						**53**

Table 3 Pitbladdo 16cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	8	0	0	5	5	**18**
Betula	5	0	0	0	0	**5**
Alnus	7	0	0	0	0	**7**
Salix	1	0	0	0	0	**1**
Coryloid	11	1	0	0	0	**12**
Ericaceae	25	0	0	0	0	**25**
Gramineae	46	2	0	51	4	**103**
Cereal type	2	0	0	0	0	**2**
Cyperaceae	8	0	0	64	2	**74**
Caryophyllaceae	2	0	0	0	1	**3**
Chenopodiaceae	1	0	0	0	0	**1**
Filipendula	8	0	0	0	0	**8**
Plantago lanceolata	3	0	0	1	0	**4**
Compositae lig.	9	0	0	0	0	**9**
Artemisia	2	0	0	0	0	**2**
Taraxacum	3	0	0	0	0	**3**
Pteridium	1	0	0	0	0	**1**
Filicales undiff.	18	0	0	0	7	**25**
Total	**160**	**3**	**0**	**121**	**19**	**303**
Sphagnum	6	0	0	0	0	**6**
Nymphaea	1	0	0	0	0	**1**
Myriophyllum sp	1	0	0	2	0	**3**
Callitriche	1	0	0	0	0	**1**
Typha latifolia	1	0	0	0	0	**1**
Indeterminate	0	2	0	0	2	**4**
Lycopodium clavatum						**66**
Pediastrum						**2**
Carbon frags.						**50**

Table 4 Pitbladdo 24cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	8	0	0	0	0	**8**
Betula	8	0	0	0	0	**8**
Alnus	9	0	0	0	0	**9**
Salix	3	0	0	0	0	**3**
Coryloid	21	0	0	0	0	**21**
Ericaceae	21	0	0	0	0	**21**
Gramineae	46	3	0	61	2	**112**
Cereal type	1	0	0	0	0	**1**
Cyperaceae	27	3	0	22	0	**52**
Ranunculus type	4	0	0	0	0	**4**
Caryophyllaceae	3	0	0	0	0	**3**
Chenopodiaceae	3	0	0	0	0	**3**
Filipendula	6	0	0	0	0	**6**
Malus / Viola	1	0	0	0	0	**1**
Umbelliferae	1	0	0	0	0	**1**
Rumex acetosa / sella	1	0	0	0	0	**1**
Plantago lanceolata	3	0	0	0	0	**3**
Sambucus racemosa	1	0	0	0	0	**1**
Compositae lig.	3	0	0	0	0	**3**
Cirsium	1	0	0	0	0	**1**
Polypodium undiff.	2	0	0	0	0	**2**
Pteridium	5	0	0	0	0	**5**
Thelypteris palutris	3	0	0	0	0	**3**
Filicales undiff.	12	0	0	7	10	**29**
Total	**193**	**6**	**0**	**90**	**12**	**301**
Nymphaea	1	0	0	0	0	**1**
Myriophyllum sp	2	0	0	0		**2**
Callitriche	2	0	0	0	0	**2**
Typha latifolia	1	0	0	0	0	**1**
Indeterminate	C3	0	0	0	0	**3**
Lycopodium clavatum						**64**
Pediastrum						**3**
Carbon frags.						**47**

Table 5 Pitbladdo 32cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	1	0	**2**
Betula	12	0	0	0	0	**12**
Alnus	12	0	0	0	0	**12**
Salix	29	0	0	0	0	**29**
Coryloid	23	0	0	0	0	**23**
Ericaceae	5	0	0	0	0	**5**
Gramineae	67	1	0	34	3	**105**
Cereal type	1	0	0	0	0	**1**
Cyperaceae	18	0	0	22	1	**41**
Ranunculus type	3	0	0	0	0	**3**
Caryophyllaceae	2	0	0	0	0	**2**
Chenopodiaceae	2	0	0	0	0	**2**
Filipendula	3	0	0	0	0	**3**
Malus / Viola	0	0	1	0	0	**1**
Umbelliferae	1	1	0	0	0	**2**
Rumex acetosa / sella	6	0	0	0	0	**6**
Lysimachia vulgaris	1	0	0	0	0	**1**
Plantago lanceolata	13	0	0	0	0	**13**
Sambucus racemosa	2	0	0	0	0	**2**
Compositae lig.	1	0	0	0	0	**1**
Cirsium	1	0	0	0	0	**1**
Lactuca	2	0	0	0	0	**2**
Polypodium undiff.	1	0	0	0	0	**1**
Pteridium	4	0	0	0	0	**4**
Thelypteris palutris	6	0	0	0	1	**7**
Filicales undiff.	18	1	0	0	9	**28**
Total	**234**	**3**	**1**	**57**	**14**	**309**
Nymphaea	2	0	0	0	0	**2**
Myriophyllum sp	4	0	0	0	0	**4**
Callitriche	4	0	0	0	0	**4**
Potamogeton	2	0	0	0	0	**2**
Typha latifolia	3	0	0	0	0	**3**
Indeterminate	C1	1	1	0	0	**3**
Lycopodium clavatum						**64**
Pediastrum						**5**
Carbon frags.						**9**

Table 6 Pitbladdo 40cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	3	0	0	0	0	**3**
Betula	15	1	0	1	0	**17**
Alnus	19	0	1	0	0	**20**
Quercus	3	0	0	0	0	**3**
Ulmus	1	0	0	0	0	**1**
Coryloid	39	4	0	2	0	**45**
Ericaceae	11	0	0	0	0	**11**
Gramineae	55	1	0	24	9	**89**
Cereal type	0	0	0	0	1	**1**
Cyperaceae	24	0	0	27	5	**56**
Ranunculus type	3	0	0	0	0	**3**
Rumex acetosa / sella	3	0	0	0	0	**3**
Plantago lanceolata	15	0	0	3	0	**18**
Plantago media / major	1	0	0	0	0	**1**
Compositae lig.	1	0	0	0	0	**1**
Polypodium undiff.	1	0	0	0	0	**1**
Thelypteris undiff.	2	0	0	0	0	**2**
Filicales undiff.	13	7	0	3	9	**32**
Dryopteris undiff.	1	0	0	0	0	**1**
Total	**210**	**13**	**1**	**60**	**24**	**308**
Sphagnum	2	0	0	0	0	**2**
Nymphaea	5	0	0	0	0	**5**
Myriophyllum sp	3	0	0	2	0	**5**
Callitriche	8	0	0	4	0	**12**
Indeterminate	C2	6	0	1	1	**10**
Lycopodium clavatum						**38**
Pediastrum						**14**
Carbon frags.						**7**

Table 7 Pitbladdo 48cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Betula	25	1	0	3	2	**31**
Alnus	20	2	0	0	1	**23**
Quercus	4	0	0	0	0	**4**
Ulmus	2	0	0	0	0	**2**
Salix	1	0	0	0	0	**1**
Coryloid	31	1	0	3	0	**35**
Ericaceae	6	1	0	0	0	**7**
Gramineae	61	0	0	0	12	**106**
Cereal type	1	0	0	0	0	**1**
Cyperaceae	8	0	0	26	4	**38**
Ranunculus type	4	0	0	0	0	**4**
Papaver undiff.	1	0	0	0	0	**1**
Caryophyllaceae	0	0	0	1	0	**1**
Filipendula	3	0	0	0	0	**3**
Umbelliferae	1	0	0	0	0	**1**
Rumex acetosa / sella	4	0	0	0	0	**4**
Pedicularis	1	0	0	0	0	**1**
Plantago lanceolata	8	0	0	1	0	**9**
Plantago media / major	1	0	0	0	0	**1**
Galium type	1	0	0	0	0	**1**
Viburnum	1	0	0	0	0	**1**
Pteridium	1	0	0	0	1	**2**
Thelypteris undiff.	1	0	0	0	0	**1**
Filicales undiff.	13	5	0	0	12	**30**
Total	**199**	**10**	**0**	**34**	**32**	**308**
Nymphaea	3	0	0	9	0	**12**
Nuphar	1	0	0	0	0	**1**
Myriophyllum sp	9	0	0	0	0	**9**
Callitriche	17	0	0	4	0	**21**
Potamogeton	3	0	0	3	0	**6**
Typha latifolia	2	0	0	0	0	**2**
Indeterminate	C7	0	0	4	3	**14**
Lycopodium clavatum						25
Pediastrum						17
Carbon frags.						14

Table 8 Pitbladdo 56cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	0	1	**2**
Betula	20	2	0	2	0	**24**
Alnus	35	1	0	0	0	**36**
Quercus	3	0	0	0	0	**3**
Ulmus	2	0	0	0	0	**2**
Salix	1	0	0	0	0	**1**
Coryloid	51	4	0	3	0	**58**
Ericaceae	7	0	0	0	0	**7**
Gramineae	71	1	0	39	3	**114**
Cereal type	2	0	0	0	0	**2**
Cyperaceae	2	0	0	14	1	**17**
Ranunculus type	2	0	0	0	0	**2**
Filipendula	2	0	0	0	0	**2**
Rumex acetosa / sella	3	0	0	0	0	**3**
Humulus / Cannabis	1	0	0	1	0	**2**
Plantago lanceolata	12	0	0	1	0	**13**
Plantago media / major	1	0	0	0	0	**1**
Artemisia	1	0	0	0	0	**1**
Polypodium undiff.	2	0	0	0	0	**2**
Filicales undiff.	4	3	0	0	3	**10**
Total	**223**	**11**	**0**	**60**	**8**	**302**
Sphagnum	2	0	0	0	0	**2**
Nymphaea	8	0	0	0	0	**8**
Myriophyllum sp	7	0	0	0	0	**7**
Callitriche	11	0	0	6	0	**17**
Typha latifolia	1	0	0	0	0	**1**
Indeterminate	C2	4	0	1	2	**9**
Lycopodium clavatum						**20**
Pediastrum						**11**
Carbon frags.						**23**

Table 9 Pitbladdo 64cm						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	1	3	**5**
Betula	27	3	0	2	0	**32**
Alnus	33	5	0	0	0	**38**
Quercus	6	0	0	0	0	**6**
Ulmus	2	0	0	0	0	**2**
Salix	2	0	0	0	0	**2**
Coryloid	52	6	0	2	0	**60**
Ericaceae	2	0	0	0	0	**2**
Gramineae	43	0	0	42	4	**89**
Cereal type	0	0	0	1	0	**1**
Cyperaceae	1	2	0	12	0	**15**
Ranunculus type	2	0	0	0	0	**2**
Chenopodiaceae	2	0	0	0	0	**2**
Filipendula	1	0	0	0	0	**1**
Rumex acetosa / sella	4	0	0	1	0	**5**
Plantago lanceolata	6	0	0	3	0	**9**
Plantago media / major	2	0	0	0	0	**2**
Polypodium undiff.	1	0	0	0	0	**1**
Pteridium	1	0	0	1	1	**3**
Thelypteris undiff.	1	0	0	0	0	**1**
Filicales undiff.	16	7	0	4	9	**36**
Total	**205**	**23**	**0**	**69**	**17**	**314**
Sphagnum	1	0	0	0	0	**1**
Nymphaea	5	0	0	0	0	**5**
Myriophyllum sp	9	0	0	0	1	**10**
Callitriche	1	0	0	0	0	**1**
Potamogeton	3	0	0	1	0	**4**
Typha latifolia	1	0	0	1	0	**2**
Indeterminate	C2	4	1	1	2	**10**
Lycopodium clavatum						**31**
Pediastrum						**10**
Carbon frags.						**18**

Table 10 Pitbladdo 72cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	0	0	0	0	1	**1**
Betula	9	0	0	0	1	**10**
Alnus	26	3	1	0	1	**31**
Quercus	6	0	0	0	0	**6**
Ulmus	5	0	0	0	0	**5**
Salix	1	0	0	0	0	**1**
Coryloid	58	6	0	0	1	**65**
Ericaceae	4	0	0	0	0	**4**
Gramineae	44	10	1	32	8	**95**
Cyperaceae	2	0	0	12	4	**18**
Ranunculus type	4	0	0	0	0	**4**
Chenopodiaceae	2	0	0	0	0	**2**
Filipendula	2	0	0	0	0	**2**
Rumex acetosa / sella	6	0	0	0	0	**6**
Plantago lanceolata	8	0	0	0	0	**8**
Plantago media / major	2	0	0	0	0	**2**
Aster type	4	0	0	0	0	**4**
Polypodium undiff.	1	0	0	0	0	**1**
Pteridium	1	0	0	0	0	**1**
Thelypteris undiff.	1	0	0	0	0	**1**
Filicales undiff.	21	7	0	1	7	**36**
Total	**207**	**26**	**2**	**45**	**23**	**303**
Sphagnum	1	0	0	0	0	**1**
Nymphaea	7	0	0	0	0	**7**
Myriophyllum sp	9	0	0	1	0	**10**
Callitriche	1	0	0	0	0	**1**
Potamogeton	3	0	0	1	0	**4**
Indeterminate	C3	4	1	1	2	**11**
Lycopodium clavatum						**21**
Pediastrum						**14**
Carbon frags.						**22**

Table 11 Pitbladdo 80cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	1	3	**5**
Betula	15	2	0	3	1	**21**
Alnus	31	1	2	0	0	**34**
Quercus	4	1	0	0	0	**5**
Ulmus	1	0	0	0	0	**1**
Salix	3	0	0	0	0	**3**
Coryloid	72	6	0	3	1	**82**
Ericaceae	4	0	0	0	0	**4**
Gramineae	28	2	0	25	3	**58**
Cyperaceae	2	2	0	0	17	**21**
Ranunculus type	2	0	0	0	0	**2**
Filipendula	2	0	0	0	0	**2**
Rumex acetosa / sella	3	0	0	0	0	**3**
Plantago lanceolata	8	0	0	2	0	**10**
Plantago media / major	1	0	0	0	0	**1**
Compositae Tub.	1	0	0	0	0	**1**
Taraxacum	1	0	0	0	0	**1**
Pteridium	3	0	0	1	0	**4**
Filicales undiff.	17	12	0	1	10	**40**
Dryopteris type	2	0	0	0	0	**2**
Total	**201**	**26**	**2**	**36**	**35**	**300**
Sphagnum	1	0	0	0	0	**1**
Nymphaea	3	0	0	0	0	**3**
Nuphar	1	0	0	0	0	**1**
Myriophyllum sp	7	1	0	1	0	**9**
Callitriche	1	0	0	0	0	**1**
Potamogeton	0	0	0	1	0	**1**
Indeterminate	C4	5	1	7	2	**19**
Lycopodium clavatum						**22**
Pediastrum						**5**
Carbon frags.						**9**

Table 12 Pitbladdo 88cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	0	0	0	0	1	**1**
Betula	22	2	0	5	0	**29**
Alnus	16	5	0	0	1	**22**
Quercus	1	0	0	0	0	**1**
Ulmus	6	0	0	0	0	**6**
Salix	2	0	0	0	0	**2**
Coryloid	56	12	0	2	0	**70**
Ericaceae	3	0	0	0	0	**3**
Gramineae	40	6	0	32	10	**88**
Cereal type	0	1	0	1	0	**2**
Cyperaceae	0	1	0	14	1	**16**
Ranunculus type	2	0	0	0	0	**2**
Filipendula	2	0	0	0	0	**2**
Rumex acetosa / sella	5	1	0	0	0	**6**
Plantago lanceolata	7	1	0	1	0	**9**
Plantago media / major	1	0	0	0	1	**2**
Compositae tub.	1	0	0	0	0	**1**
Pteridium	0	0	0	0	1	**1**
Total	**164**	**29**	**0**	**55**	**15**	**263**
Sphagnum	1	0	0	0	0	**1**
Nymphaea	6	0	0	3	0	**9**
Myriophyllum sp	4	0	0	0	0	**4**
Indeterminate	C5	7	1	2	1	**16**
Lycopodium clavatum						**21**
Pediastrum						**12**
Carbon frags.						**19**

Table 13 Pitbladdo 96cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	1	1	1	**4**
Betula	23	2	0	1	0	**26**
Alnus	19	0	1	0	0	**20**
Quercus	6	0	0	0	0	**6**
Ulmus	2	0	0	0	0	**2**
Salix	4	0	0	0	0	**4**
Coryloid	55	12	1	2	0	**70**
Ericaceae	3	0	0	0	0	**3**
Gramineae	69	3	0	38	4	**114**
Cyperaceae	1	0	0	0	0	**1**
Chenopodiaceae	1	0	0	0	1	**2**
Rumex acetosa / sella	4	0	0	0	0	**4**
Plantago lanceolata	6	0	0	0	0	**6**
Taraxacum	3	0	0	0	0	**3**
Polypodium undiff.	1	0	0	0	0	**1**
Pteridium	2	0	0	0	0	**2**
Filicales undiff.	12	4	0	1	13	**30**
Dryopteris undiff.	3	0	0	0	0	**3**
Total	**215**	**21**	**3**	**43**	**19**	**301**
Sphagnum	2	0	0	0	0	**2**
Nymphaea	3	0	0	0	0	**3**
Myriophyllum sp	16	1	0	0	0	**17**
Callitriche	2	0	0	0	0	**2**
Potamogeton	1	0	0	1	0	**2**
Typha latifolia	1	0	0	0	0	**1**
Indeterminate	C2	3	0	2	0	**7**
Lycopodium clavatum						**22**
Pediastrum						**15**
Carbon frags.						**8**

Table 14 Pitbladdo 100cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	4	1	0	0	2	**7**
Betula	21	2	2	1	1	**27**
Alnus	16	2	6	0	0	**25**
Quercus	3	0	0	0	0	**3**
Ulmus	1	1	1	0	0	**3**
Salix	2	0	0	0	0	**2**
Coryloid	38	9	2	0	1	**50**
Ericaceae	2	0	0	0	0	**2**
Gramineae	50	7	0	34	6	**97**
Cyperaceae	4	1	0	17	2	**24**
Ranunculus type	3	0	0	0	0	**3**
Filipendula	1	0	0	0	0	**1**
Rumex acetosa / sella	2	0	0	0	0	**2**
Humulus / Cannabis	1	0	0	0	0	**1**
Trientalis europaea	1	0	0	0	0	**1**
Plantago lanceolata	4	0	0	0	0	**4**
Plantago media / major	2	0	0	0	0	**2**
Compositae tub.	2	0	0	0	0	**2**
Taraxacum	2	0	0	0	0	**2**
Pteridium	3	1	0	1	0	**5**
Filicales undiff.	18	5	0	2	16	**41**
Total	**180**	**29**	**11**	**55**	**28**	**304**
Sphagnum	3	0	0	0	0	**3**
Nymphaea	3	0	0	2	0	**5**
Myriophyllum sp	6	3	0	1	0	**10**
Hippuris vulgaris	1	0	0	0	0	**1**
Callitriche	3	0	0	0	0	**3**
Potamogeton	2	0	0	2	0	**4**
Typha latifolia	1	0	0	0	0	**1**
Indeterminate	C7	2	1	3	0	**13**
Lycopodium clavatum						**19**
Pediastrum						**11**
Carbon frags.						**10**

Table 15 Pitbladdo 108cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	0	2	**3**
Betula	31	1	0	2	0	**34**
Alnus	25	2	1	0	1	**29**
Quercus	5	0	0	0	0	**5**
Ulmus	1	0	0	0	0	**1**
Tilia	1	0	0	0	0	**1**
Salix	1	0	0	0	0	**1**
Coryloid	48	9	0	1	1	**59**
Ericaceae	3	0	0	0	0	**3**
Gramineae	45	3	1	40	5	**94**
Cereal type	0	0	0	2	0	**2**
Cyperaceae	3	2	0	11	0	**16**
Ranunculus type	3	0	0	0	0	**3**
Caryophyllaceae	1	0	0	0	0	**1**
Chenopodiaceae	1	0	0	0	0	**1**
Filipendula	2	0	0	0	0	**2**
Umbelliferae	1	0	0	0	0	**1**
Rumex acetosa / sella	1	0	0	1	0	**2**
Humulus / Cannabis	1	0	0	0	0	**1**
Plantago lanceolata	5	0	0	2	0	**7**
Plantago media / major	4	0	0	0	0	**4**
Pteridium	3	0	0	0	0	**3**
Filicales undiff.	11	7	0	0	7	**25**
Dryopteris undiff.	3	0	0	0	0	**3**
Total	**200**	**24**	**2**	**59**	**16**	**301**
Nymphaea	1	0	0	0	0	**1**
Myriophyllum sp	15	1	0	0	0	**16**
Callitriche	1	0	0	0	0	**1**
Typha latifolia	1	0	0	0	0	**1**
Indeterminate	C4	4	1	1	5	**15**
Lycopodium clavatum						**31**
Pediastrum						**7**
Carbon frags.						**10**

Table 16 Pitbladdo 116cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	0	2	**3**
Betula	15	3	0	2	1	**21**
Alnus	19	4	2	2	1	**28**
Quercus	2	0	0	0	1	**3**
Ulmus	4	0	0	0	0	**4**
Salix	1	1	0	0	0	**2**
Coryloid	48	26	0	3	2	**79**
Ericaceae	3	0	0	0	0	**3**
Gramineae	34	8	1	33	6	**82**
Cyperaceae	1	1	0	7	0	**10**
Ranunculus type	5	1	0	0	0	**6**
Rumex acetosa / sella	3	0	0	1	0	**4**
Plantago lanceolata	13	0	0	0	0	**13**
Plantago media / major	2	0	0	0	0	**2**
Compositae tub.	4	0	0	0	0	**4**
Taraxacum	1	0	0	0	0	**1**
Pteridium	2	0	0	0	0	**2**
Filicales undiff.	17	13	0	0	8	**38**
Dryopteris undiff.	1	0	0	0	0	**1**
Total	**176**	**57**	**3**	**48**	**21**	**306**
Sphagnum	2	0	0	0	0	**2**
Nymphaea	2	0	0	0	0	**2**
Myriophyllum sp	11	0	0	0	0	**11**
Potamogeton	0	0	0	1	0	**1**
Typha latifolia	1	0	0	0	0	**1**
Indeterminate	C3	3	1	5	6	**18**
Lycopodium clavatum						**32**
Pediastrum						**10**
Carbon frags.						**6**

Table 17 Pitbladdo 124cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	2	0	0	0	2	**4**
Betula	26	4	0	1	0	**31**
Alnus	27	0	2	0	0	**29**
Quercus	7	0	0	0	0	**7**
Ulmus	4	0	0	0	0	**4**
Salix	1	0	0	0	0	**1**
Coryloid	61	8	0	1	0	**70**
Gramineae	69	3	0	24	7	**103**
Cyperaceae	2	0	0	1	0	**3**
Ranunculus type	4	0	0	0	0	**4**
Rumex acetosa / sella	5	0	0	0	0	**5**
Urtica type	1	0	0	0	0	**1**
Plantago lanceolata	12	1	0	1	1	**15**
Plantago media / major	1	0	0	0	0	**1**
Compositae lig.	2	0	0	0	0	**2**
Aster type	1	0	0	0	0	**1**
Taraxacum	1	0	0	0	0	**1**
Pteridium	3	0	0	0	0	**3**
Filicales undiff.	10	2	0	0	5	**17**
Total	**239**	**18**	**2**	**28**	**15**	**302**
Nymphaea	2	0	0	0	0	**2**
Myriophyllum sp	13	0	1	0	0	**14**
Callitriche	1	0	0	0	0	**1**
Potamogeton	0	0	0	2	0	**2**
Typha latifolia	2	0	0	0	0	**2**
Indeterminate	C5	4	1	0	1	**11**
Lycopodium clavatum						**36**
Pediastrum						**22**
Tilletia sphagni						**1**
Carbon frags.						**17**

Table 18 Pitbladdo 132cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	0	2	**3**
Betula	16	4	0	5	1	**26**
Alnus	25	3	0	0	1	**29**
Quercus	4	1	0	0	0	**5**
Ulmus	2	0	0	2	0	**4**
Salix	2	0	0	0	0	**2**
Coryloid	52	13	2	2	0	**69**
Ericaceae	6	0	0	0	0	**5**
Gramineae	37	7	0	35	8	**87**
Cereal type	0	0	0	1	0	**1**
Cyperaceae	0	5	0	16	0	**21**
Filipendula	4	0	0	0	0	**4**
Rumex acetosa / sella	3	0	0	0	0	**3**
Urtica type	1	0	0	0	0	**1**
Humulus / Cannabis	1	0	0	0	0	**1**
Plantago lanceolata	4	0	0	0	0	**4**
Plantago media / major	1	0	0	0	0	**1**
Compositae lig.	1	0	0	0	0	**1**
Pteridium	1	0	0	0	0	**1**
Filicales undiff.	16	6	0	1	9	**32**
Dryopteris undiff.	1	0	0	0	0	**1**
Total	**178**	**39**	**2**	**62**	**21**	**301**
Sphagnum	1	0	0	0	0	**1**
Nymphaea	5	0	0	0	0	**5**
Myriophyllum sp	6	0	0	0	0	**6**
Potamogeton	2	0	0	0	0	**2**
Typha latifolia	2	0	0	0	0	**2**
Indeterminate	C2	7	1	2	1	**13**
Lycopodium clavatum						**34**
Pediastrum						**10**
Carbon frags.						**11**

Table 19 Pitbladdo 140cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	0	0	0	0	4	**4**
Betula	10	0	0	1	0	**11**
Alnus	30	6	6	0	1	**43**
Quercus	1	0	0	0	0	**1**
Ulmus	3	0	0	0	0	**3**
Salix	1	0	0	0	0	**1**
Coryloid	57	16	1	0	0	**74**
Ericaceae	5	0	0	0	0	**5**
Gramineae	41	5	0	39	4	**89**
Cyperaceae	5	5	0	14	2	**26**
Ranunculus type	1	0	0	0	0	**1**
Chenopodiaceae	1	0	0	0	0	**1**
Filipendula	1	0	0	0	0	**1**
Rumex acetosa / sella	4	0	0	0	0	**4**
Anagallis	1	0	0	0	0	**1**
Plantago lanceolata	5	0	0	1	1	**7**
Plantago media / major	1	0	0	1	0	**2**
Compositae tub.	5	0	0	0	0	**5**
Polypodium undiff.	1	0	0	0	0	**1**
Pteridium	1	0	0	0	0	**1**
Filicales undiff.	11	9	0	1	6	**27**
Total	**185**	**41**	7	57	**18**	**308**
Nymphaea	0	0	0	2	0	**2**
Myriophyllum sp	8	1	0	1	1	**11**
Callitriche	2	0	0	0	0	**2**
Typha latifolia	1	1	0	0	0	**2**
Indeterminate	C5	6	5	2	1	**19**
Lycopodium clavatum						**23**
Pediastrum						**28**
Carbon frags.						**6**

Table 20 Pitbladdo 148cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	2	0	0	0	3	**5**
Betula	24	4	0	0	0	**28**
Alnus	37	2	2	1	0	**42**
Quercus	5	0	0	0	0	**5**
Ulmus	5	0	0	0	0	**5**
Salix	3	0	0	0	0	**3**
Coryloid	51	13	0	1	0	**65**
Ericaceae	2	0	0	0	0	**2**
Gramineae	57	11	0	26	7	**101**
Cyperaceae	0	0	0	1	0	**1**
Ranunculus type	1	0	0	0	0	**1**
Filipendula	1	0	0	0	0	**1**
Rumex acetosa / sella	4	0	0	0	0	**4**
Anagallis	2	0	0	0	0	**2**
Plantago lanceolata	3	0	0	4	0	**7**
Taraxacum	1	0	0	0	0	**1**
Polypodium undiff.	1	0	0	0	0	**1**
Pteridium	3	0	0	1	1	**5**
Filicales undiff.	13	2	0	1	11	**27**
Dryopteris undiff.	2	0	0	0	0	**2**
Blechnum spicant	1	0	0	0	0	**1**
Total	**218**	**32**	**2**	**35**	**22**	**309**
Nymphaea	4	0	0	0	0	**4**
Myriophyllum sp	7	0	0	0	0	**7**
Potamogeton	1	0	0	0	0	**1**
Typha latifolia	1	0	0	0	0	**1**
Indeterminate	C4	5	2	2	4	**17**
Lycopodium clavatum						**29**
Pediastrum						**16**
Carbon frags.						**14**

Table 21 Pitbladdo 156cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	4	0	0	0	3	**7**
Betula	20	2	0	1	0	**23**
Alnus	25	4	5	1	0	**35**
Quercus	0	1	0	0	0	**1**
Ulmus	4	0	0	0	0	**4**
Salix	2	0	0	0	0	**2**
Coryloid	82	10	0	0	2	**84**
Ericaceae	2	0	0	0	0	**2**
Gramineae	42	9	0	16	4	**70**
Cereal type	0	0	0	1	0	**1**
Cyperaceae	3	2	0	4	0	**9**
Ranunculus type	4	0	0	0	0	**4**
Filipendula	3	0	0	0	0	**3**
Rumex acetosa / sella	2	0	0	0	0	**2**
Plantago lanceolata	6	0	1	0	0	**7**
Rubiaceae	1	0	0	0	0	**1**
Taraxacum	1	0	0	0	0	**1**
Polypodium undiff.	1	0	0	0	0	**1**
Pteridium	3	1	0	0	0	**4**
Filicales undiff.	18	5	0	4	13	**40**
Dryopteris undiff.	1	0	0	0	0	**1**
Total	**224**	**34**	**6**	**27**	**22**	**302**
Nymphaea	4	0	0	0	0	**4**
Myriophyllum sp	7	1	0	0	0	**8**
Hippuris vulgaris	1	0	0	0	0	**1**
Potamogeton	4	0	0	0	0	**4**
Indeterminate	C7	6	2	2	1	**18**
Lycopodium clavatum						**15**
Pediastrum						**6**
Carbon frags.						**10**

Table 22 Pitbladdo 164cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	0	0	**1**
Betula	21	2	0	1	0	**25**
Alnus	23	2	3	2	0	**30**
Quercus	7	0	0	0	0	**7**
Ulmus	2	0	0	3	0	**5**
Salix	1	0	0	0	0	**1**
Coryloid	60	8	0	0	2	**70**
Ericaceae	4	1	0	0	0	**5**
Gramineae	47	4	1	22	10	**84**
Cyperaceae	3	2	0	8	3	**16**
Filipendula	1	0	0	0	0	**1**
Rumex acetosa / sella	5	0	0	0	0	**5**
Plantago lanceolata	7	0	1	1	0	**9**
Plantago media / major	2	0	0	1	0	**3**
Taraxacum	1	0	0	0	0	**1**
Polypodium undiff.	2	0	0	0	0	**2**
Pteridium	3	0	0	1	1	**5**
Filicales undiff.	12	4	0	1	15	**32**
Total	**202**	**23**	**5**	**40**	**31**	**302**
Nymphaea	5	0	0	1	0	**6**
Callitriche	2	0	0	0	0	**2**
Potamogeton	2	0	0	1	0	**3**
Typha latifolia	1	0	0	0	0	**1**
Indeterminate	C6	11	1	1	0	**19**
Lycopodium clavatum						**26**
Pediastrum						**2**
Carbon frags.						**17**

Table 23 Pitbladdo 172cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	2	0	0	1	2	**5**
Betula	12	2	0	1	2	**17**
Alnus	14	2	5	0	0	**21**
Quercus	3	1	0	0	0	**4**
Ulmus	1	1	0	0	0	**2**
Coryloid	71	8	0	1	0	**80**
Ericaceae	6	0	0	0	0	**6**
Gramineae	48	7	1	29	10	**95**
Cereal type	1	0	0	1	0	**2**
Cyperaceae	6	1	0	6	0	**13**
Ranunculus type	1	0	0	1	0	**2**
Filipendula	1	0	0	0	0	**1**
Rumex acetosa / sella	4	1	0	0	0	**5**
Plantago lanceolata	6	0	0	0	0	**6**
Plantago media / major	1	0	0	0	0	**1**
Compositae tub.	1	0	0	0	0	**1**
Polypodium undiff.	3	0	0	0	1	**4**
Pteridium	4	0	0	0	0	**4**
Filicales undiff.	15	3	0	3	12	**33**
Dryopteris undiff.	2	0	0	0	0	**2**
Total	**202**	**26**	**6**	**43**	**27**	**304**
Sphagnum	2	0	0	0	0	**2**
Nymphaea	3	0	0	0	0	**3**
Myriophyllum sp	1	0	0	1	0	**2**
Callitriche	3	0	0	1	0	**4**
Potamogeton	0	1	0	0	0	**1**
Typha latifolia	1	0	0	0	0	**1**
Indeterminate	C3	4	0	2	2	**11**
Lycopodium clavatum						**21**
Pediastrum						**3**
Carbon frags.						**15**

Table 24 Pitbladdo 180cm						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	0	1	**2**
Betula	18	4	1	2	2	**27**
Alnus	31	11	6	0	2	**50**
Quercus	4	0	0	0	0	**4**
Ulmus	3	0	0	0	0	**3**
Salix	2	0	0	0	0	**2**
Coryloid	56	11	0	1	3	**71**
Gramineae	39	8	0	19	14	**80**
Cereal type	1	0	0	0	0	**1**
Cyperaceae	0	1	0	2	0	**3**
Ranunculus type	1	0	0	0	0	**1**
Caryophyllaceae	0	0	0	1	0	**1**
Rumex acetosa / sella	4	1	0	0	0	**5**
Plantago lanceolata	5	0	0	1	0	**6**
Plantago media / major	3	0	0	1	0	**4**
Compositae tub.	1	0	0	0	0	**1**
Taraxacum	1	0	0	0	0	**1**
Polypodium undiff.	2	0	0	0	0	**2**
Pteridium	1	0	0	1	0	**2**
Filicales undiff.	16	4	0	3	14	**37**
Dryopteris undiff.	1	0	0	0	0	**1**
Total	**190**	**40**	**7**	**31**	**36**	**304**
Sphagnum	1	0	0	0	0	**1**
Nymphaea	3	0	0	0	0	**3**
Myriophyllum sp	3	0	0	0	0	**3**
Callitriche	2	0	0	0	0	**2**
Typha latifolia	1	0	0	0	0	**1**
Indeterminate	C6	14	4	0	0	**24**
Lycopodium clavatum						**21**
Pediastrum						**6**
Carbon frags.						**10**

Table 25 Pitbladdo 188cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	2	0	0	0	1	**3**
Betula	11	4	0	0	0	**15**
Alnus	22	8	3	0	2	**35**
Quercus	10	1	0	0	0	**11**
Ulmus	9	1	0	0	0	**10**
Salix	1	0	0	0	0	**1**
Coryloid	77	23	0	0	1	**101**
Ericaceae	1	0	0	0	0	**1**
Gramineae	35	10	1	27	6	**79**
Cyperaceae	3	5	0	3	0	**11**
Filipendula	1	0	0	0	0	**1**
Rumex acetosa / sella	2	0	0	0	0	**2**
Plantago lanceolata	2	0	0	0	0	**2**
Compositae lig.	1	0	0	0	0	**1**
Pteridium	5	0	0	1	1	**7**
Thelypteris undiff.	1	0	0	0	0	**1**
Filicales undiff.	15	5	0	0	7	**27**
Total	**198**	**57**	**4**	**31**	**18**	**308**
Nymphaea	2	0	0	1	0	**3**
Myriophyllum sp	4	0	0	0	0	**4**
Callitriche	2	0	0	0	0	**2**
Typha latifolia	1	0	0	0	0	**1**
Indeterminate	0	12	0	2	2	**16**
Lycopodium clavatum						**21**
Pediastrum						**2**
Carbon frags.						**8**

Table 26 Pitbladdo 196cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	4	0	0	1	1	**6**
Betula	13	5	0	3	0	**21**
Alnus	41	6	3	0	1	**49**
Quercus	9	0	0	0	0	**9**
Ulmus	1	1	0	0	0	**2**
Salix	3	0	0	0	0	**3**
Coryloid	51	23	0	3	0	**81**
Ericaceae	5	0	0	0	0	**5**
Gramineae	27	6	0	16	5	**54**
Cereal type	1	0	0	0	0	**1**
Cyperaceae	1	2	0	11	0	**14**
Ranunculus type	2	0	0	0	0	**2**
Chenopodiaceae	1	0	0	0	0	**1**
Rubiaceae	1	0	0	0	0	**1**
Rumex acetosa / sella	4	0	0	0	0	**4**
Plantago lanceolata	3	0	0	0	0	**3**
Plantago media / major	1	0	0	0	0	**1**
Compositae tub.	1	0	0	0	0	**1**
Polypodium undiff.	1	0	0	0	0	**1**
Pteridium	4	0	0	0	1	**5**
Filicales undiff.	26	2	0	0	11	**39**
Total	**200**	**45**	**3**	**34**	**19**	**303**
Nymphaea	2	0	0	0	0	**2**
Myriophyllum sp	4	0	0	0	0	**4**
Potamogeton	0	0	0	2	1	**3**
Indeterminate	C1	7	1	1	0	**10**
Lycopodium clavatum						**22**
Pediastrum						**2**
Carbon frags.						**16**

Table 27 Pitbladdo 200cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	3	0	0	0	1	**4**
Betula	19	5	0	2	1	**27**
Alnus	31	13	0	0	0	**44**
Quercus	6	1	0	0	0	**7**
Ulmus	3	2	0	0	0	**5**
Tilia	1	0	0	0	0	**1**
Salix	1	0	0	0	0	**1**
Coryloid	46	13	0	1	0	**65**
Ericaceae	4	0	0	0	0	**4**
Gramineae	27	5	0	24	8	**64**
Cyperaceae	0	6	0	4	2	**12**
Ranunculus type	1	0	0	0	0	**1**
Chenopodiaceae	1	0	0	0	0	**1**
Filipendula	1	0	0	0	0	**1**
Rumex acetosa / sella	6	0	0	0	0	**6**
Plantago lanceolata	3	0	0	1	0	**4**
Plantago media / major	1	0	0	0	0	**1**
Polypodium undiff.	1	0	0	0	0	**1**
Pteridium	2	0	0	0	1	**3**
Filicales undiff.	51	2	0	0	4	**57**
Dryopteris undiff.	1	0	0	0	0	**1**
Total	**209**	**47**	**0**	**32**	**17**	**310**
Sphagnum	1	0	0	0	0	**1**
Nymphaea	5	0	0	0	0	**5**
Callitriche	4	0	0	0	0	**4**
Potamogeton	1	0	0	0	0	**1**
Indeterminate	C1	11	0	3	0	**15**
Lycopodium clavatum						**21**
Pediastrum						**4**
Carbon frags.						**5**

Table 28 Pitbladdo 208cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	0	1	**2**
Betula	16	10	0	2	2	**30**
Alnus	35	11	2	0	1	**49**
Quercus	4	3	0	0	0	**7**
Ulmus	4	1	0	1	0	**6**
Salix	1	0	0	0	0	**1**
Coryloid	48	33	0	0	0	**81**
Ericaceae	2	0	0	0	0	**2**
Gramineae	26	17	0	19	7	**69**
Cereal type	1	0	0	0	0	**1**
Cyperaceae	2	1	0	4	1	**8**
Ranunculus type	1	0	0	0	0	**1**
Chenopodiaceae	1	0	0	0	0	**1**
Agrimonia eupatoria	1	0	0	0	0	**1**
Rumex acetosa / sella	4	1	0	0	0	**5**
Utriculara	1	0	0	0	0	**1**
Plantago lanceolata	1	0	0	0	0	**1**
Compositae lig.	2	0	0	0	0	**2**
Compositae tub.	3	0	0	0	0	**3**
Polypodium undiff.	2	0	0	0	0	**2**
Pteridium	5	0	0	0	1	**6**
Filicales undiff.	17	2	0	0	5	**24**
Total	**178**	**79**	**2**	**26**	**18**	**303**
Nymphaea	8	0	0	0	0	**8**
Myriophyllum sp	1	0	0	0	0	**1**
Callitriche	1	0	0	0	0	**1**
Typha latifolia	4	0	0	0	0	**4**
Indeterminate	C2	10	1	1	0	**14**
Lycopodium clavatum						**19**
Pediastrum						**2**
Carbon frags.						**10**

Table 29 Pitbladdo 216cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	1	1	**3**
Betula	13	7	2	1	1	**24**
Alnus	28	16	4	0	0	**48**
Quercus	7	3	0	0	0	**10**
Ulmus	2	0	0	1	0	**3**
Coryloid	53	29	1	0	0	**83**
Gramineae	23	9	2	21	11	**66**
Cyperaceae	1	2	0	11	2	**16**
Ranunculus type	2	0	0	0	0	**2**
Chenopodiaceae	1	0	0	0	0	**1**
Rumex acetosa / sella	5	0	0	0	0	**5**
Trientalis europaea	1	0	0	0	0	**1**
Plantago lanceolata	6	0	0	3	0	**9**
Taraxacum	1	0	0	0	0	**1**
Polypodium undiff.	1	0	0	0	0	**1**
Pteridium	1	0	0	0	2	**3**
Filicales undiff.	16	2	0	0	8	**26**
Dryopteris undiff.	1	0	0	0	0	**1**
Total	**163**	**68**	**9**	**38**	**25**	**303**
Sphagnum	3	0	0	0	0	**3**
Nymphaea	5	0	0	0	0	**5**
Myriophyllum sp	1	0	0	0	0	**1**
Callitriche	2	0	0	3	0	**5**
Potamogeton	0	0	0	2	0	**2**
Indeterminate	C6	9	0	1	1	**17**
Lycopodium clavatum						**24**
Pediastrum						**2**
Carbon frags.						**13**

Table 30 Pitbladdo 224cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	2	0	0	0	2	**4**
Betula	12	7	2	0	1	**22**
Alnus	22	15	14	0	2	**53**
Quercus	13	6	0	0	0	**19**
Ulmus	6	1	0	0	0	**7**
Coryloid	65	50	2	0	1	**113**
Ericaceae	3	0	1	0	0	**4**
Gramineae	12	8	1	7	1	**29**
Cyperaceae	0	5	0	3	0	**8**
Ranunculus tupe	3	1	0	0	0	**4**
Umbelliferae	1	0	0	0	0	**1**
Rumex acetosa / sella	4	0	0	0	0	**4**
Plantago lanceolata	1	0	0	0	0	**1**
Taraxacum	1	0	0	0	0	**1**
Polypodium undiff.	1	0	0	0	0	**1**
Pteridium	1	0	0	0	1	**2**
Filicales undiff.	16	3	0	1	6	**26**
Dryopteris undiff.	1	0	0	0	0	**1**
Total	**164**	**96**	**20**	**11**	**14**	**300**
Nymphaea	1	0	0	0	1	**2**
Callitriche	0	0	0	2	0	**2**
Typha latifolia	1	0	0	0	0	**1**
Indeterminate	C2	6	3	3	1	**15**
Lycopodium clavatum						**19**
Pediastrum						**2**
Carbon frags.						**13**

Table 31 Pitbladdo 232cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	0	0	**1**
Betula	30	7	3	1	1	**43**
Alnus	37	13	7	0	1	**58**
Quercus	7	0	0	0	0	**7**
Ulmus	3	2	0	0	0	**5**
Salix	1	0	0	0	0	**1**
Coryloid	68	27	1	0	1	**97**
Ericaceae	1	0	0	0	0	**1**
Gramineae	28	2	0	11	3	**44**
Cyperaceae	1	0	0	2	0	**3**
Ranunculus type	2	0	0	0	0	**2**
Rumex acetosa / sella	5	0	0	0	0	**5**
Polypodium undiff.	7	0	0	0	0	**7**
Pteridium	2	0	0	0	0	**2**
Filicales undiff.	17	2	0	2	7	**28**
Total	**210**	**53**	**11**	**16**	**13**	**304**
Sphagnum	1	0	0	0	0	**1**
Nymphaea	9	0	0	1	0	**10**
Callitriche	2	0	0	0	0	**2**
Potamogeton	6	0	0	0	0	**6**
Indeterminate	C3	17	2	3	0	**23**
Lycopodium clavatum						**28**
Pediastrum						**4**
Carbon frags.						**8**

Table 32 Pitbladdo 240cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	2	2	**5**
Betula	17	8	0	1	1	**27**
Alnus	27	14	5	1	0	**47**
Quercus	7	1	0	0	0	**8**
Ulmus	6	3	0	0	0	**9**
Salix	0	0	0	1	0	**1**
Coryloid	65	40	0	2	1	**108**
Ericaceae	2	0	0	1	0	**3**
Gramineae	18	6	0	10	5	**39**
Cyperaceae	2	0	0	5	0	**7**
Filipendula	1	0	0	0	0	**1**
Rumex acetosa / sella	4	0	0	0	0	**4**
Trientalis europaea	2	0	0	0	0	**2**
Compositae lig.	1	0	0	0	0	**1**
Polypodium undiff.	3	0	0	0	1	**4**
Pteridium	1	0	0	0	0	**1**
Filicales undiff.	13	11	0	4	9	**37**
Total	**170**	**83**	**5**	**27**	**19**	**304**
Sphagnum	3	0	0	0	0	**3**
Nymphaea	5	0	0	0	1	**6**
Menyanthes trifoliata	1	0	0	0	0	**1**
Indeterminate	C4	11	2	0	2	**19**
Lycopodium clavatum						**18**
Pediastrum						**4**
Carbon frags.						**14**

Table 33 Pitbladdo 244cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	4	0	0	0	1	**5**
Betula	11	5	0	1	1	**18**
Alnus	46	11	5	0	1	**63**
Quercus	9	0	0	1	0	**10**
Ulmus	5	0	0	0	0	**5**
Salix	2	0	0	0	0	**2**
Coryloid	68	36	0	0	0	**104**
Ericaceae	2	0	0	0	0	**2**
Gramineae	25	6	0	8	2	**41**
Cereal type	0	1	0	0	0	**1**
Cyperaceae	2	3	0	2	0	**7**
Caryophyllaceae	1	0	0	0	0	**1**
Chenopodiaceae	1	0	0	0	0	**1**
Filipendula	1	0	0	0	0	**1**
Rumex acetosa / sella	7	0	0	0	0	**7**
Plantago lanceolata	2	0	0	0	0	**2**
Compositae tub.	1	0	0	0	0	**1**
Polypodium undiff.	2	1	0	0	0	**3**
Filicales undiff.	12	6	0	1	8	**27**
Dryopteris undiff.	2	0	0	0	0	**2**
Total	**203**	**69**	**5**	**13**	**13**	**303**
Nymphaea	3	0	0	0	0	**3**
Nuphar	1	0	0	0	0	**1**
Myriophyllum sp	0	0	0	0	1	**1**
Callitriche	3	0	0	0	0	**3**
Potamogeton	5	0	0	0	0	**5**
Indeterminate	C3	5	0	2	0	**10**
Lycopodium clavatum						**24**
Pediastrum						**8**
Carbon frags.						**4**

Table 34 Pitbladdo 248cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	2	0	0	0	2	**4**
Betula	28	3	0	0	4	**35**
Alnus	44	16	2	0	0	**62**
Quercus	10	0	0	0	0	**10**
Ulmus	8	3	0	0	0	**11**
Coryloid	65	27	0	0	0	**92**
Hedera helix	2	0	0	0	0	**2**
Ericaceae	1	0	0	0	0	**1**
Gramineae	27	4	0	11	3	**45**
Cyperaceae	2	1	0	3	0	**6**
Ranunculus type	1	0	0	0	0	**1**
Filipendula	1	0	0	0	0	**1**
Rumex acetosa / sella	4	0	0	0	0	**4**
Plantago lanceolata	2	0	0	0	0	**2**
Taraxacum	1	0	0	0	0	**1**
Filicales undiff.	21	4	0	0	1	**26**
Athyrium filax-femina	1	0	0	0	0	**1**
Dryopteris undiff.	2	0	0	0	0	**2**
Total	**222**	**58**	**2**	**14**	**10**	**306**
Sphagnum	1	0	0	0	0	**1**
Nymphaea	2	0	0	0	0	**2**
Callitriche	1	0	0	0	0	**1**
Potamogeton	1	0	0	0	0	**1**
Indeterminate	C1	7	3	1	2	**14**
Lycopodium clavatum						**17**
Pediastrum						**7**
Carbon frags						**13**

Table 35 Pitbladdo 252cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	4	0	0	0	0	**4**
Betula	16	1	0	0	1	**18**
Alnus	62	12	5	0	2	**81**
Quercus	9	0	0	0	0	**9**
Ulmus	10	3	0	3	0	**16**
Salix	2	0	0	0	0	**2**
Coryloid	58	22	1	1	1	**83**
Hedera helix	1	0	0	0	0	**1**
Ericaceae	3	0	0	0	0	**3**
Gramineae	32	4	0	15	4	**55**
Cyperaceae	2	1	0	3	0	**6**
Ranunculus type	1	0	0	0	0	**1**
Chenopodiaceae	1	0	0	0	0	**1**
Filipendula	1	0	0	0	0	**1**
Rumex acetosa / sella	2	0	0	0	0	**2**
Plantago lanceolata	2	0	0	1	0	**3**
Plantago media / major	1	0	0	0	0	**1**
Compositae tub.	1	0	0	0	0	**1**
Polypodium undiff.	1	0	0	0	0	**1**
Pteridium	2	0	0	0	0	**2**
Filicales undiff.	6	1	0	0	5	**12**
Total	**217**	**44**	**6**	**23**	**13**	**303**
Nymphaea	5	0	0	0	0	**5**
Callitriche	2	0	0	0	0	**2**
Potamogeton	0	0	0	0	1	**1**
Indeterminate	C1	12	4	2	0	**19**
Lycopodium clavatum						**13**
Pediastrum						**4**
Carbon frags.						**8**

Table 36 Pitbladdo 256cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	0	2	**3**
Betula	19	7	2	3	1	**32**
Alnus	36	10	4	0	1	**51**
Quercus	16	1	0	0	0	**17**
Ulmus	8	0	0	1	0	**9**
Coryloid	56	34	0	1	1	**92**
Ericaceae	3	1	0	0	0	**4**
Gramineae	20	13	1	18	8	**60**
Cyperaceae	0	2	0	1	0	**3**
Ranunculus type	2	0	0	0	0	**2**
Rumex acetosa / sella	4	0	0	0	0	**4**
Polypodium undiff.	2	0	0	0	0	**2**
Filicales undiff.	15	1	0	2	5	**23**
Dryopteris undiff.	2	0	0	0	0	**2**
Total	**184**	**69**	**7**	**26**	**18**	**304**
Sphagnum	1	0	0	0	0	**1**
Nymphaea	2	0	0	1	0	**3**
Indeterminate	C4	15	1	1	2	**24**
Lycopodium clavatum						**23**
Pediastrum						**1**
Carbon frags.						**8**

Table 37 Pitbladdo 260cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	3	0	0	0	2	**5**
Betula	12	2	0	2	0	**16**
Alnus	49	14	3	0	0	**67**
Quercus	17	0	0	0	0	**17**
Ulmus	8	2	0	1	0	**11**
Coryloid	50	40	0	0	0	**90**
Gramineae	17	4	0	19	9	**49**
Cereal type	1	0	0	0	0	**1**
Cyperaceae	0	1	0	1	0	**2**
Ranunculus type	5	0	0	0	1	**6**
Rumex acetosa / sella	4	0	0	0	0	**4**
Plantago lanceolata	2	0	0	1	0	**3**
Galium type	1	0	0	0	0	**1**
Compositae lig.	1	0	0	0	0	**1**
Polypodium undiff.	1	0	0	1	0	**2**
Pteridium	3	0	0	0	0	**3**
Filicales undiff.	13	3	0	2	5	**23**
Dryopteris undiff.	1	0	0	0	0	**1**
Total	**188**	**66**	**3**	**27**	**17**	**302**
Nymphaea	2	1	0	1	0	**4**
Myriophyllum sp	1	0	0	0	0	**1**
Callitriche	2	0	0	0	0	**2**
Potamogeton	1	0	0	0	0	**1**
Indeterminate	C4	9	1	2	0	**16**
Lycopodium clavatum						**25**
Pediastrum						**15**
Carbon frags.						**1**

Table 38 Pitbladdo 264cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	0	0	0	0	2	**2**
Betula	25	2	1	1	0	**29**
Alnus	46	15	3	1	1	**66**
Quercus	17	1	0	0	1	**19**
Ulmus	5	2	1	1	0	**9**
Salix	1	0	0	0	0	**1**
Coryloid	70	32	0	1	0	**103**
Ericaceae	1	0	0	0	0	**1**
Gramineae	21	4	0	5	3	**33**
Cyperaceae	1	2	0	0	0	**3**
Ranunculus type	1	0	0	0	0	**1**
Rumex acetosa / sella	2	0	0	0	0	**2**
Plantago lanceolata	2	0	0	0	0	**2**
Compositae lig.	3	0	0	0	0	**3**
Taraxacum	1	0	0	0	0	**1**
Filicales undiff.	11	5	0	0	9	**25**
Dryopteris undiff.	1	0	0	0	0	**1**
Total	**208**	**63**	**5**	**9**	**16**	**301**
Nymphaea	7	0	0	0	0	**7**
Callitriche	2	0	0	0	0	**2**
Potamogeton	2	0	0	0	0	**2**
Indeterminate	C1	5	0	0	3	**9**
Lycopodium clavatum						**14**
Pediastrum						**5**
Carbon frags.						**4**

Table 39 Pitbladdo 268cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	0	0	0	0	4	**4**
Betula	10	2	1	0	1	**14**
Alnus	47	11	3	0	1	**62**
Quercus	16	0	0	0	0	**16**
Ulmus	9	2	0	0	0	**11**
Salix	1	0	0	0	0	**1**
Coryloid	97	38	0	1	1	**137**
Ericaceae	2	0	0	0	0	**2**
Gramineae	11	3	1	11	1	**27**
Cyperaceae	1	0	0	3	0	**4**
Ranunculus type	1	0	0	0	0	**1**
Caryophyllaceae	3	0	0	0	0	**3**
Rumex acetosa / sella	3	0	0	0	0	**3**
Trientalis europaea	1	0	0	0	0	**1**
Plantago lanceolata	3	0	0	2	0	**5**
Polypodium undiff.	1	0	0	0	0	**1**
Filicales undiff.	9	3	0	1	3	**16**
Total	**215**	**59**	**5**	**18**	**11**	**308**
Callitriche	1	0	0	0	0	**1**
Indeterminate	C3	11	2	1	0	**17**
Lycopodium clavatum						**35**
Pediastrum						**9**
Carbon frags.						**4**

Table 40 Pitbladdo 272cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	0	1	**2**
Betula	14	2	0	1	0	**17**
Alnus	37	10	3	0	0	**50**
Quercus	15	3	0	1	0	**19**
Ulmus	9	1	1	4	0	**15**
Salix	3	0	0	0	0	**3**
Coryloid	89	30	0	1	0	**120**
Gramineae	19	5	0	12	1	**37**
Cereal type	1	0	0	0	0	**1**
Cyperaceae	2	1	0	3	0	**6**
Ranunculus type	1	1	0	0	0	**2**
Rumex acetosa / sella	6	1	0	1	0	**8**
Plantago lanceolata	2	0	0	1	0	**3**
Compositae tub.	1	0	0	0	0	**1**
Polypodium undiff.	2	0	0	0	0	**2**
Filicales undiff.	9	2	0	2	4	**17**
Dryopteris undiff.	1	0	0	0	0	**1**
Total	**212**	**56**	**4**	**26**	**6**	**304**
Sphagnum	1	0	0	0	0	**1**
Nymphaea	2	0	0	0	0	**2**
Nuphar	1	0	0	0	0	**1**
Potamogeton	1	0	0	0	0	**1**
Indeterminate	C1	11	5	5	2	**24**
Lycopodium clavatum						**15**
Pediastrum						**13**
Carbon frags.						**8**

Table 41 Pitbladdo 276cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	3	0	0	0	1	**4**
Betula	11	3	0	0	1	**15**
Alnus	47	14	2	1	1	**65**
Quercus	8	0	0	0	0	**8**
Ulmus	11	1	0	0	0	**12**
Coryloid	88	34	0	2	1	**125**
Ericaceae	1	0	0	0	0	**1**
Gramineae	14	2	0	10	2	**28**
Cyperaceae	2	0	0	3	0	**5**
Ranunculus type	1	0	0	0	0	**1**
Filipendula	1	0	0	0	0	**1**
Rumex acetosa / sella	4	0	0	0	0	**4**
Plantago lanceolata	3	0	0	1	0	**4**
Plantago media / major	1	0	0	0	0	**1**
Polypodium undiff.	1	0	0	0	0	**1**
Filicales undiff.	18	2	0	0	6	**26**
Total	**214**	**56**	**2**	**17**	**12**	**301**
Sphagnum	0	0	0	0	1	**1**
Myriophyllum sp	1	0	0	0	0	**1**
Callitriche	1	0	0	0	0	**1**
Potamogeton	2	0	0	0	0	**2**
Indeterminate	C2	15	2	2	0	**21**
Lycopodium clavatum						**15**
Pediastrum						**8**
Carbon frags.						**10**

Table 42 Pitbladdo 280cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	2	0	0	0	3	**5**
Betula	16	2	0	0	1	**19**
Alnus	42	12	2	0	2	**58**
Quercus	13	1	0	0	0	**14**
Ulmus	3	3	0	0	0	**6**
Salix	1	0	0	0	0	**1**
Coryloid	90	30	1	0	1	**122**
Gramineae	19	1	0	13	2	**35**
Cyperaceae	0	4	0	2	1	**7**
Rumex acetosa / sella	7	0	0	0	0	**7**
Plantago lanceolata	2	0	0	0	0	**2**
Plantago media / major	1	0	0	0	0	**1**
Compositae tub.	1	0	0	0	0	**1**
Polypodium undiff.	1	0	0	0	1	**2**
Filicales undiff.	15	5	1	1	2	**24**
Dryopteris undiff.	1	0	0	0	0	**1**
Total	**214**	**58**	**4**	**16**	**13**	**305**
Sphagnum	1	0	0	0	0	**1**
Nymphaea	2	0	0	0	0	**2**
Nuphar	1	0	0	0	0	**1**
Callitriche	1	0	0	0	0	**1**
Potamogeton	2	0	0	0	0	**2**
Indeterminate	C1	3	0	0	1	**5**
Lycopodium clavatum	30					**30**
Pediastrum						**3**
Carbon frags.						**11**

Table 43 Pitbladdo 284cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	0	2	**3**
Betula	18	2	0	0	1	**21**
Alnus	58	1	1	0	0	**60**
Quercus	12	0	0	0	0	**12**
Ulmus	10	0	1	0	0	**11**
Salix	1	0	0	0	0	**1**
Coryloid	88	20	0	0	2	**111**
Hedera helix	0	0	0	1	0	**1**
Gramineae	26	0	0	11	5	**42**
Cyperaceae	3	0	0	1	0	**4**
Ranunculus type	2	0	0	0	0	**2**
Rumex acetosa / sella	9	0	0	0	0	**9**
Plantago lanceolata	1	0	0	0	0	**1**
Compositae tub.	1	0	0	0	0	**1**
Polypodium undiff.	3	0	0	0	0	**3**
Pteridium	1	0	0	0	0	**1**
Filicales undiff.	14	1	0	0	2	**17**
Dryopteris undiff.	3	0	0	0	0	**3**
Total	**251**	**24**	**2**	**13**	**12**	**303**
Myriophyllum sp	0	1	0	0	0	**1**
Potamogeton	2	0	0	0	1	**3**
Typha latifolia	1	0	0	0	0	**1**
Indeterminate	C5	11	3	0	0	**19**
Lycopodium clavatum						**15**
Pediastrum						**3**
Carbon frags.						**4**

Table 44 Pitbladdo 288cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	0	1	**2**
Betula	22	2	0	2	0	**26**
Alnus	54	18	2	0	1	**75**
Quercus	10	2	1	0	0	**13**
Ulmus	12	0	0	1	0	**13**
Coryloid	95	19	0	0	1	**115**
Gramineae	12	2	0	6	4	**24**
Cyperaceae	0	2	0	3	0	**5**
Ranunculus type	1	0	0	0	1	**2**
Filipendula	1	0	0	0	0	**1**
Rumex acetosa / sella	4	1	0	0	0	**5**
Polypodium undiff.	1	0	0	0	0	**1**
Pteridium	3	0	0	0	0	**3**
Filicales undiff.	8	3	0	1	7	**19**
Total	**224**	**49**	**3**	**13**	**15**	**304**
Sphagnum	1	0	0	0	0	**1**
Nymphaea	2	0	0	0	0	**2**
Callitriche	2	0	0	0	0	**2**
Indeterminate	C3	9	2	1	2	**17**
Lycopodium clavatum						**11**
Pediastrum						**1**
Carbon frags.						**8**

Table 45 Pitbladdo 292cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	0	0	0	0	3	**3**
Betula	15	9	0	0	0	**24**
Alnus	43	24	5	0	3	**76**
Quercus	12	0	0	0	0	**12**
Ulmus	10	2	0	3	0	**15**
Coryloid	74	34	0	0	1	**109**
Gramineae	20	5	0	8	3	**36**
Cyperaceae	0	0	0	4	0	**4**
Ranunculus type	1	0	0	0	0	**1**
Filipendula	2	0	0	0	0	**2**
Rumex acetosa / sella	2	0	0	0	0	**2**
Polypodium undiff.	1	0	0	0	0	**1**
Filicales undiff.	11	1	0	0	2	**14**
Dryopteris undiff.	2	0	0	0	0	**2**
Total	**193**	**75**	**5**	**15**	**12**	**301**
Sphagnum	1	0	0	0	0	**1**
Nymphaea	2	0	0	0	0	**2**
Callitriche	2	0	0	0	0	**2**
Potamogeton	1	0	0	0	0	**1**
Indeterminate	C1	5	1	0	1	**8**
Lycopodium clavatum						**18**
Pediastrum						**2**
Carbon frags.						**6**

Table 46 Pitbladdo 296cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	2	1	0	1	4	**8**
Betula	26	7	0	0	0	**33**
Alnus	56	12	3	0	2	**73**
Quercus	19	0	0	0	0	**19**
Ulmus	8	1	0	3	0	**12**
Coryloid	66	31	1	0	1	**99**
Gramineae	17	1	0	12	3	**33**
Cyperaceae	1	0	0	1	0	**2**
Rumex acetosa / sella	6	1	0	0	0	**7**
Plantago media / major	1	0	0	0	0	**1**
Compositae tub.	1	0	0	0	0	**1**
Taraxacum	2	0	0	0	0	**2**
Polypodium undiff.	2	0	0	0	0	**2**
Filicales undiff.	7	1	0	3	3	**14**
Total	**214**	**55**	**4**	**20**	**13**	**306**
Nymphaea	1	0	0	0	0	**1**
Callitriche	1	0	0	0	0	**1**
Potamogeton	1	0	0	1	0	**2**
Indeterminate	0	20	2	1	0	**23**
Lycopodium clavatum						**38**
Pediastrum						**2**
Carbon frags.						**6**

Table 47 Pitbladdo 300 cm						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	2	0	0	0	2	**4**
Betula	30	1	0	0	0	**31**
Alnus	32	29	7	0	7	**75**
Quercus	9	0	0	0	0	**9**
Ulmus	12	0	0	0	0	**12**
Tilia	1	0	0	0	0	**1**
Coryloid	51	44	3	0	5	**103**
Gramineae	9	10	0	12	3	**34**
Cyperaceae	3	0	0	0	0	**3**
Filipendula	1	0	0	0	0	**1**
Rumex acetosa / sella	3	0	0	0	0	**3**
Plantago lanceolata	1	0	0	0	0	**1**
Compositae tub.	1	0	0	0	0	**1**
Polypodium undiff.	2	0	0	0	0	**2**
Filicales undiff.	4	0	0	12	3	**19**
Dryopteris undiff.	1	0	0	0	0	**1**
Total	**162**	**84**	**10**	**24**	**20**	**300**
Sphagnum	1	0	0	0	0	**1**
Nymphaea	1	0	0	0	0	**1**
Callitriche	1	0	0	0	0	**1**
Indeterminate	C2	16	2	0	0	**20**
Lycopodium clavatum						**23**
Pediastrum						**1**
Carbon fragments						**8**

Table 48 Pitbladdo 302cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	0	2	**3**
Betula	16	7	1	0	1	**25**
Alnus	38	25	6	1	3	**73**
Quercus	8	2	0	0	0	**10**
Ulmus	5	0	0	2	0	**7**
Tilia	2	0	0	0	0	**2**
Coryloid	46	49	0	3	3	**101**
Gramineae	20	7	1	14	7	**49**
Cyperaceae	0	5	0	5	0	**10**
Ranunculus type	2	0	0	0	0	**2**
Rosaceae undiff.	1	0	0	0	0	**1**
Filipendula	1	0	0	0	0	**1**
Rumex acetosa / sella	4	1	0	0	0	**5**
Urtica type	1	0	0	1	0	**2**
Plantago lanceolata	2	0	0	0	0	**2**
Polypodium undiff.	2	0	0	0	0	**2**
Pteridium	0	0	0	0	1	**1**
Filicales undiff.	5	6	0	2	2	**15**
Total	**154**	**102**	**8**	**28**	**19**	**311**
Sphagnum	0	1	0	0	0	**1**
Nymphaea	2	0	0	0	0	**2**
Myriophyllum spicatum	1	0	0	0	0	**1**
Callitriche	3	0	0	1	0	**4**
Indeterminate	C4	10	4	12	0	**30**
Lycopodium clavatum						**11**
Pediastrum						**3**
Carbon frags.						**8**

Table 49 Pitbladdo 304cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	0	0	0	2	2	**4**
Betula	12	5	0	1	1	**19**
Alnus	42	25	6	2	0	**75**
Quercus	17	4	0	0	0	**21**
Ulmus	7	1	0	2	0	**10**
Coryloid	59	34	0	0	0	**93**
Gramineae	21	4	0	20	12	**57**
Cyperaceae	2	0	0	2	0	**4**
Ranunculus type	1	0	0	0	0	**1**
Rumex acetosa / sella	3	0	0	0	0	**3**
Plantago lanceolata	1	0	0	0	0	**1**
Composite tub.	1	0	0	0	0	**1**
Filicales undiff.	9	3	0	0	4	**16**
Total	**175**	**76**	**6**	**29**	**19**	**305**
Sphagnum	3	0	1	0	0	**4**
Nymphaea	4	0	0	0	0	**4**
Myriophyllum sp	4	0	0	0	0	**4**
Callitriche	1	0	0	1	0	**2**
Typha latifolia	0	1	0	0	0	**1**
Indeterminate	C1	12	1	1	1	**16**
Lycopodium clavatum						**29**
Pediastrum						**7**
Carbon frags.						**9**

Table 50 Pitbladdo 306cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	3	1	**5**
Betula	23	5	1	3	1	**33**
Alnus	25	21	3	0	1	**50**
Quercus	14	3	0	2	0	**19**
Ulmus	2	2	0	1	0	**5**
Salix	1	0	0	0	0	**1**
Coryloid	58	51	1	3	7	**120**
Ericaceae	3	0	0	1	0	**4**
Gramineae	19	11	0	12	7	**49**
Cereal type	0	1	0	0	0	**1**
Cyperaceae	1	0	0	1	0	**2**
Ranunculus type	1	0	0	0	0	**1**
Rosaceae undiff.	1	0	0	0	0	**1**
Filipendula	1	1	0	0	0	**2**
Rumex acetosa / sella	7	2	0	0	0	**9**
Urtica type	0	0	0	1	0	**1**
Plantago lanceolata	3	0	0	1	0	**4**
Compositae tub.	1	1	0	0	0	**2**
Pteridium	2	0	0	1	1	**4**
Filicales undiff.	6	4	0	0	8	**18**
Total	**169**	**102**	**5**	**29**	**26**	**331**
Nymphaea	2	0	0	0	0	**2**
Myriophyllum spicatum	1	0	0	0	0	**1**
Callitriche	1	0	0	0	0	**1**
Indeterminate	C4	18	2	4	1	**29**
Lycopodium clavatum						**11**
Pediastrum						**4**
Carbon frags.						**4**

Table 51 Pitbladdo 308cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	0	1	**2**
Betula	17	3	0	0	0	**20**
Alnus	43	12	8	0	0	**63**
Quercus	18	1	0	0	0	**19**
Ulmus	4	3	0	2	0	**9**
Salix	3	0	0	0	0	**3**
Coryloid	56	52	0	0	0	**108**
Gramineae	16	0	0	10	7	**33**
Cyperaceae	0	2	0	6	0	**8**
Ranunculus type	3	0	0	0	0	**3**
Chenopodiaceae	1	0	0	0	0	**1**
Filipendula	1	0	0	0	0	**1**
Rumex acetosa / sella	6	1	0	0	0	**7**
Plantago lanceolata	3	0	0	0	0	**3**
Compositae tub.	1	0	0	0	0	**1**
Taraxacum	1	0	0	0	0	**1**
Polypodium undiff.	1	0	0	0	0	**1**
Pteridium	1	0	0	0	3	**4**
Filicales undiff.	8	6	0	1	3	**18**
Total	**184**	**80**	**8**	**19**	**14**	**305**
Nymphaea	2	0	0	0	0	**2**
Callitriche	1	0	0	1	0	**2**
Indeterminate	C1	8	6	0	0	**15**
Lycopodium clavatum						**24**
Pediastrum						**4**
Carbon frags.						**10**

Table 52 Pitbladdo 310cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	0	0	0	0	1	**1**
Betula	11	7	0	0	0	**18**
Alnus	41	33	7	0	1	**82**
Quercus	7	1	0	2	0	**10**
Ulmus	4	1	0	1	0	**6**
Coryloid	60	45	2	3	0	**110**
Ericaceae	0	0	0	1	0	**1**
Gramineae	21	7	0	7	4	**39**
Cyperaceae	1	2	0	1	0	**4**
Ranunculus type	1	0	0	0	0	**1**
Rosaceae undiff.	1	0	0	0	0	**1**
Filipendula	1	0	0	0	0	**1**
Rumex acetosa / sella	7	2	0	1	0	**10**
Urtica type	0	0	0	2	0	**2**
Plantago lanceolata	2	0	0	1	0	**3**
Compositae lig.	1	0	0	0	0	**1**
Pteridium	1	0	0	1	0	**2**
Filicales undiff.	6	2	0	2	4	**14**
Total	**165**	**100**	**9**	**22**	**10**	**306**
Callitriche	3	0	0	0	0	**3**
Potamogeton	0	0	0	1	0	**1**
Indeterminate	C5	11	3	8	1	**28**
Lycopodium clavatum						**11**
Pediastrum						**7**
Carbon frags.						**7**

Table 53 Pitbladdo 312cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	1	2	**4**
Betula	21	2	1	0	0	**24**
Alnus	41	10	10	0	0	**61**
Quercus	18	2	0	2	0	**22**
Ulmus	3	0	0	0	0	**3**
Salix	1	0	0	0	0	**1**
Coryloid	71	36	3	0	0	**110**
Gramineae	24	1	0	8	3	**36**
Cereal type	0	1	0	0	0	**1**
Cyperaceae	0	1	0	1	0	**2**
Ranunculus type	4	0	0	0	0	**4**
Rosaceae undiff.	1	0	0	0	0	**1**
Filipendula	1	0	0	0	0	**1**
Rumex acetosa / sella	4	0	0	0	0	**4**
Plantago lanceolata	2	0	0	0	0	**2**
Plantago media / major	1	0	0	0	0	**1**
Polypodium undiff.	3	0	0	1	1	**5**
Filicales undiff.	11	2	0	0	5	**18**
Dryopteris undiff.	1	0	0	0	0	**1**
Total	**208**	**55**	**14**	**13**	**11**	**301**
Nymphaea	2	0	0	0	0	**2**
Indeterminate	C6	5	5	3	1	**20**
Lycopodium clavatum						**44**
Pediastrum						**2**
Carbon frags.						**14**

Table 54 Pitbladdo 314cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	1	0	1	0	**3**
Betula	11	5	1	0	1	**19**
Alnus	50	32	4	1	1	**88**
Quercus	9	0	0	1	0	**10**
Ulmus	5	2	0	0	0	**7**
Coryloid	68	44	2	3	0	**117**
Gramineae	23	10	0	10	3	**46**
Cereal type	0	0	0	0	1	**1**
Cyperaceae	0	0	0	1	0	**1**
Ranunculus type	0	1	0	0	0	**1**
Chenopodiaceae	1	0	0	0	0	**1**
Filipendula	2	0	0	0	0	**2**
Rumex acetosa / sella	4	0	0	0	0	**4**
Plantago lanceolata	0	1	0	0	0	**1**
Compositae lig.	1	0	0	0	0	**1**
Polypodium undiff.	1	0	0	0	0	**1**
Pteridium	1	0	0	0	1	**2**
Filicales undiff.	9	0	0	1	3	**13**
Total	**186**	**96**	7	**18**	**10**	**318**
Nymphaea	0	0	0	0	2	**2**
Callitriche	1	0	0	0	0	**1**
Indeterminate	C7	14	6	5	4	**36**
Lycopodium clavatum						**24**
Carbon frags.						**6**

Table 55 Pitbladdo 316cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	3	0	0	0	1	**4**
Betula	20	4	1	0	1	**26**
Alnus	72	8	2	0	0	**82**
Quercus	24	0	0	0	1	**25**
Ulmus	5	3	0	1	0	**9**
Coryloid	61	24	0	0	0	**90**
Gramineae	37	0	0	3	3	**43**
Cereal type	1	0	0	0	0	**1**
Cyperaceae	1	0	0	3	0	**4**
Caryophyllaceae	1	0	0	0	0	**1**
Chenopodiaceae	1	0	0	0	0	**1**
Umbelliferae	1	0	0	0	0	**1**
Rumex acetosa / sella	1	0	0	0	0	**1**
Compositae tub.	1	0	0	0	0	**1**
Polypodium undiff.	1	0	0	0	0	**1**
Pteridium	2	0	0	0	0	**2**
Filicales undiff.	13	1	0	0	2	**16**
Total	**245**	**40**	**3**	**7**	**8**	**308**
Nymphaea	1	0	0	0	0	**1**
Myriophyllum sp	1	0	0	0	0	**1**
Callitriche	2	0	0	0	0	**2**
Indeterminate	C2	11	0	1	0	**14**
Lycopodium clavatum						**11**
Pediastrum						**1**
Carbon frags.						**6**

Table 56 Pitbladdo 318cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	0	0	0	0	1	**1**
Betula	12	7	0	1	3	**23**
Alnus	43	27	9	0	1	**80**
Quercus	7	0	0	2	0	**9**
Ulmus	2	0	0	1	0	**3**
Coryloid	64	42	2	3	0	**111**
Gramineae	15	4	0	12	4	**35**
Cereal type	1	0	0	0	0	**1**
Cyperaceae	1	3	0	1	0	**5**
Chenopodiaceae	1	0	0	0	0	**1**
Filipendula	1	0	0	0	0	**1**
Rumex acetosa / sella	5	1	0	1	0	**7**
Urtica type	1	1	0	1	0	**3**
Plantago lanceolata	4	0	0	0	0	**4**
Polypodium undiff.	2	0	0	0	0	**2**
Pteridium	3	0	0	1	0	**4**
Filicales undiff.	11	2	1	1	5	**20**
Dryopteris undiff.	1	0	0	0	0	**1**
Total	**174**	**87**	**12**	**24**	**14**	**311**
Nymphaea	1	0	0	0	0	**1**
Myriophyllum spicatum	0	1	0	0	0	**1**
Indeterminate	C2	8	4	4	2	**20**
Lycopodium clavatum						**9**
Pediastrum						**4**
Carbon frags.						**10**

Table 57 Pitbladdo 320cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	0	3	**4**
Betula	12	2	0	0	0	**14**
Alnus	42	12	14	0	1	**69**
Quercus	16	0	0	0	0	**16**
Ulmus	1	0	2	1	0	**4**
Salix	1	0	0	0	0	**1**
Coryloid	79	34	1	0	0	**114**
Ericaceae	2	0	0	0	0	**2**
Gramineae	26	2	0	12	3	**43**
Cyperaceae	2	0	0	4	0	**6**
Rumex acetosa / sella	5	0	0	0	0	**5**
Plantago lanceolata	2	0	0	1	0	**3**
Diphasiastrum	1	0	0	0	0	**1**
Polypodium undiff.	2	0	0	0	0	**2**
Pteridium	1	0	0	0	0	**1**
Filicales undiff.	11	4	0	0	3	**18**
Dryopteris undiff.	1	0	0	0	0	**1**
Total	**205**	**54**	**17**	**18**	**10**	**304**
Nymphaea	2	0	0	0	0	**2**
Nuphar	1	0	0	0	0	**1**
Myriophyllum sp	3	0	0	0	0	**3**
Typha latifolia	1	0	0	0	0	**1**
Indeterminate	C1	5	7	0	1	**14**
Lycopodium clavatum						**28**
Pediastrum						**5**
Carbon frags.						**12**

Table 58 Pitbladdo 322cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	0	0	0	1	0	**1**
Betula	17	9	2	1	0	**29**
Alnus	33	19	4	2	2	**60**
Quercus	11	1	0	2	1	**15**
Ulmus	1	3	0	1	0	**5**
Salix	3	0	0	0	0	**3**
Coryloid	54	45	3	2	0	**104**
Gramineae	23	8	2	19	7	**59**
Cyperaceae	0	1	0	3	0	**4**
Ranunculus type	1	0	0	0	0	**1**
Rosaceae undiff.	1	0	0	0	0	**1**
Rumex acetosa / sella	2	0	0	2	0	**4**
Urtica type	4	0	0	0	0	**4**
Plantago lanceolata	3	1	0	0	0	**4**
Compositae tub.	1	0	0	0	0	**1**
Polypodium undiff.	2	0	0	0	0	**2**
Pteridium	0	0	0	1	0	**1**
Filicales undiff.	11	4	0	2	1	**8**
Blechnum spicant	2	0	0	0	0	**2**
Total	**169**	**91**	**11**	**36**	**11**	**308**
Sphagnum	1	0	0	0	0	**1**
Nymphaea	1	0	0	0	0	**1**
Nuphar	1	0	0	0	0	**1**
Hippuris vulgaris	1	0	0	0	0	**1**
Callitriche	1	0	0	0	0	**1**
Potamogeton	1	0	0	0	0	**1**
Indeterminate	C2	13	4	7	3	**29**
Lycopodium clavatum						**13**
Pediastrum						**10**
Carbon frags.						5

Table 59 Pitbladdo 324cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	3	0	0	0	1	**4**
Betula	14	2	1	0	0	**17**
Alnus	50	10	13	0	0	**73**
Quercus	14	2	0	0	0	**16**
Ulmus	8	4	0	0	0	**12**
Salix	1	0	0	0	0	**1**
Coryloid	70	38	1	0	1	**114**
Ericaceae	1	0	0	0	0	**1**
Gramineae	19	4	0	11	5	**39**
Cyperaceae	0	1	0	6	1	**8**
Caryophyllaceae	1	0	0	0	0	**1**
Rumex acetosa / sella	4	1	0	0	0	**5**
Plantago lanceolata	1	0	0	0	0	**1**
Plantago media / major	1	0	0	0	0	**1**
Taraxacum	1	0	0	0	0	**1**
Pteridium	2	0	0	0	0	**2**
Filicales undiff.	6	0	0	1	0	**7**
Total	**196**	**62**	**15**	**18**	**8**	**303**
Sphagnum	1	0	0	0	0	**1**
Nymphaea	1	0	0	0	0	**1**
Callitriche	1	0	0	0	0	**1**
Indeterminate	C5	3	3	1	1	**13**
Lycopodium clavatum						**29**
Pediastrum						**1**
Carbon frags.						**14**

Table 60 Pitbladdo 326cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	1	3	**5**
Betula	18	5	0	1	3	**27**
Alnus	58	21	2	1	4	**86**
Quercus	5	0	0	1	0	**6**
Ulmus	1	3	0	1	0	**5**
Coryloid	59	46	0	1	2	**108**
Ericaceae	1	0	0	0	0	**1**
Gramineae	20	5	0	13	10	**48**
Cereal type	1	0	0	1	0	**2**
Cyperaceae	0	6	0	4	0	**10**
Ranunculus type	0	1	0	0	0	**1**
Trifolium type	1	0	0	0	0	**1**
Filipendula	1	0	0	0	0	**1**
Rumex acetosa / sella	4	0	0	1	0	**5**
Plantago lanceolata	1	0	0	0	0	**1**
Polypodium undiff.	1	0	0	0	0	**1**
Pteridium	2	0	0	0	0	**2**
Filicales undiff.	6	3	0	0	3	**12**
Dryopteris undiff.	1	0	0	0	0	**1**
Total	**181**	**90**	**2**	**25**	**25**	**323**
Callitriche	0	0	0	1	0	**1**
Indeterminate	C3	7	5	6	2	**23**
Lycopodium clavatum						**9**
Pediastrum						**5**
Carbon frags.						**9**

Table 61 Pitbladdo 328cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	4	0	0	0	4	**8**
Betula	21	7	1	0	0	**29**
Alnus	50	7	15	1	0	**73**
Quercus	23	0	0	1	0	**24**
Ulmus	5	1	0	0	0	**6**
Salix	4	0	0	0	0	**4**
Coryloid	88	31	0	2	2	**123**
Gramineae	29	2	0	13	4	**48**
Cyperaceae	0	0	0	2	0	**2**
Ranunculus type	1	0	0	0	1	**2**
Filipendula	1	0	0	0	0	**1**
Rumex acetosa / sella	6	0	0	0	0	**6**
Trientalis europaea	1	0	0	0	0	**1**
Plantago lanceolata	2	0	0	0	0	**2**
Plantago media / major	0	0	1	0	0	**1**
Polypodium undiff.	3	0	0	0	0	**3**
Pteridium	2	1	0	0	0	**3**
Filicales undiff.	10	0	0	0	5	**15**
Dryopteris undiff.	2	0	0	0	0	**2**
Total	**252**	**49**	**17**	**19**	**16**	**353**
Nymphaea	1	0	0	0	0	**1**
Myriophyllum sp	1	0	0	0	0	**1**
Callitriche	1	0	0	1	0	**2**
Typha latifolia	1	0	0	1	0	**1**
Indeterminate	C6	3	8	2	1	**20**
Lycopodium clavatum						**36**
Pediastrum						**4**
Carbon frags.						**17**

Table 62 Pitbladdo 330cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	2	0	0	0	2	**4**
Betula	11	10	1	2	1	**25**
Alnus	39	34	8	2	5	**88**
Quercus	13	1	0	3	0	**17**
Ulmus	11	1	0	2	1	**15**
Salix	1	0	0	0	0	**1**
Coryloid	57	43	2	3	1	**106**
Hedera helix	1	0	0	0	0	**1**
Ericaceae	0	1	0	0	0	**1**
Gramineae	13	7	0	9	1	**30**
Cyperaceae	0	4	0	2	0	**6**
Filipendula	1	0	0	0	0	**1**
Rumex acetosa / sella	6	1	0	0	0	**7**
Urtica type	2	0	0	1	0	**3**
Compositae tub.	1	0	0	0	0	**1**
Pteridium	1	0	0	0	0	**1**
Filicales undiff.	6	0	0	0	2	**8**
Total	**165**	**102**	**11**	**24**	**13**	**315**
Nymphaea	3	0	0	1	0	**4**
Myriophyllum spicatum	2	0	0	0	0	**2**
Indeterminate	C6	16	3	10	3	**38**
Lycopodium clavatum						**17**
Pediastrum						**1**
Carbon frags.						**10**

Table 63 Pitbladdo 332cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	0	2	**3**
Betula	17	5	1	3	1	**27**
Alnus	37	12	6	0	1	**56**
Quercus	18	1	0	0	0	**19**
Ulmus	3	1	0	0	0	**4**
Salix	3	0	0	1	0	**4**
Coryloid	52	45	1	2	0	**100**
Ericaceae	1	0	0	0	0	**1**
Gramineae	19	7	0	12	4	**42**
Cyperaceae	1	3	0	3	0	**7**
Ranunculus type	1	0	0	0	0	**1**
Umbelliferae	1	0	0	0	0	**1**
Rumex acetosa / sella	5	0	0	0	0	**5**
Plantago lanceolata	2	1	0	0	0	**3**
Compositae tub.	1	0	0	0	0	**1**
Polypodium undiff.	1	0	0	0	0	**1**
Pteridium	4	0	0	0	0	**4**
Filicales undiff.	15	1	0	0	4	**21**
Total	**182**	**76**	**8**	**21**	**12**	**300**
Sphagnum	2	0	0	0	0	**2**
Nymphaea	2	0	0	0	0	**2**
Callitriche	0	0	0	1	0	**1**
Potamogeton	0	0	0	1	0	**1**
Typha latifolia	0	0	0	1	0	**1**
Indeterminate	C1	11	0	0	1	**13**
Lycopodium clavatum						**37**
Carbon frags.						**10**

Table 64 Pitbladdo 334cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	0	2	**3**
Betula	16	7	1	1	0	**25**
Alnus	31	39	8	0	1	**79**
Quercus	18	2	0	0	0	**20**
Ulmus	6	5	0	0	0	**11**
Salix	1	0	0	0	0	**1**
Coryloid	56	52	0	2	1	**111**
Ericaceae	1	0	0	0	0	**1**
Gramineae	19	3	0	7	5	**34**
Cyperaceae	2	5	0	4	0	**11**
Ranunculus type	3	0	0	0	1	**4**
Filipendula	2	1	0	0	0	**3**
Rumex acetosa / sella	10	1	0	0	0	**11**
Urtica type	1	0	0	1	0	**2**
Trientalis europaea	1	0	0	0	0	**1**
Plantago lanceolata	2	1	0	0	0	**3**
Taraxacum	1	0	0	0	0	**1**
Polypodium undiff.	4	0	0	0	0	**4**
Pteridium	0	0	0	0	2	**2**
Filicales undiff.	4	0	0	0	4	**8**
Total	**179**	**116**	**9**	**15**	**16**	**335**
Callitriche	2	0	0	0	0	**2**
Indeterminate	C4	21	4	9	4	**42**
Lycopodium clavatum						**13**
Pediastrum						**6**
Carbon frags.						**4**

Table 65 Pitbladdo 336cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	4	0	0	0	3	7
Betula	15	3	0	1	0	**19**
Alnus	33	9	3	0	0	**45**
Quercus	23	1	0	0	0	**24**
Ulmus	16	3	0	2	0	**21**
Salix	1	0	0	0	0	**1**
Coryloid	43	59	0	0	0	**102**
Ericaceae	2	0	0	0	0	**2**
Gramineae	24	2	0	6	7	**39**
Cyperaceae	1	5	0	2	0	**8**
Ranunculus type	1	0	0	0	0	**1**
Rumex acetosa / sella	9	0	0	0	0	**9**
Plantago lanceolata	2	0	0	1	0	**3**
Polypodium undiff.	3	0	0	0	0	**3**
Pteridium	3	0	0	0	0	**3**
Filicales undiff.	9	1	0	1	6	**17**
Total	**189**	**83**	**3**	**13**	**16**	**304**
Nymphaea	4	0	0	0	0	**4**
Callitriche	0	0	0	1	0	**1**
Indeterminate	C2	9	0	1	1	**14**
Lycopodium clavatum						**23**
Pediastrum						**7**
Carbon frags.						**7**

Table 66 Pitbladdo 338cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	0	1	**2**
Betula	15	9	0	1	1	**26**
Alnus	46	40	8	0	1	**95**
Quercus	15	4	0	2	1	**22**
Ulmus	10	10	0	2	0	**22**
Salix	1	0	0	0	0	**1**
Coryloid	37	51	1	2	1	**92**
Hedera helix	1	0	0	0	0	**1**
Gramineae	20	5	0	7	8	**40**
Cyperaceae	0	0	0	3	1	**4**
Ranunculus type	1	2	0	0	0	**3**
Rumex acetosa / sella	6	1	0	1	0	**8**
Urtica type	1	0	0	1	0	**2**
Plantago lanceolata	2	0	0	0	0	**2**
Polypodium undiff.	1	0	0	0	0	**1**
Pteridium	1	0	0	0	2	**3**
Filicales undiff.	8	0	0	0	1	**9**
Total	**166**	**122**	**9**	**19**	**17**	**333**
Sphagnum	1	0	0	0	0	**1**
Nymphaea	1	0	0	0	0	**1**
Callitriche	2	0	0	0	0	**2**
Indeterminate	C4	22	4	5	5	**40**
Lycopodium clavatum						**15**
Pediastrum						**6**
Carbon frags.						**6**

Table 67 Pitbladdo 340cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	2	0	0	0	1	**3**
Betula	13	14	0	0	0	**27**
Alnus	43	21	5	0	1	**70**
Quercus	25	9	0	0	0	**34**
Ulmus	6	2	0	1	0	**9**
Coryloid	72	44	1	1	0	**118**
Ericaceae	4	0	0	0	0	**4**
Gramineae	20	3	0	7	4	**34**
Cereal type	1	0	0	0	0	**1**
Cyperaceae	0	3	0	10	2	**15**
Rumex acetosa / sella	7	1	0	0	0	**8**
Trientalis europaea	2	0	0	0	0	**2**
Plantago lanceolata	1	0	0	0	0	**1**
Compositae tub.	1	0	0	0	0	**1**
Polypodium undiff.	2	0	0	0	0	**2**
Pteridium	3	0	0	0	0	**3**
Filicales undiff.	6	0	0	1	6	**13**
Total	**208**	**97**	**6**	**20**	**14**	**345**
Nymphaea	3	0	0	0	0	**3**
Callitriche	0	0	0	0	0	**1**
Potamogeton	1	0	0	0	0	**1**
Indeterminate	C3	11	7	3	1	**25**
Lycopodium clavatum						**32**
Pediastrum						**1**
Carbon frags.						**6**

Table 68 Pitbladdo 342cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	2	0	0	1	3	**6**
Betula	11	15	0	2	0	**27**
Alnus	21	31	7	1	2	**62**
Quercus	18	1	0	0	1	**20**
Ulmus	12	10	0	0	0	**22**
Salix	1	0	0	0	0	**1**
Coryloid	58	62	3	3	1	**127**
Gramineae	6	3	0	3	3	**15**
Cyperaceae	1	0	0	4	0	**5**
Ranunculus type	1	0	0	0	0	**1**
Caryophyllaceae	1	0	0	0	0	**1**
Rumex acetosa / sella	9	1	0	1	0	**11**
Urtica type	2	0	0	0	0	**2**
Pteridium	2	1	0	0	0	**3**
Filicales undiff.	8	1	0	0	2	**11**
Total	**153**	**125**	**10**	**15**	**12**	**314**
Nymphaea	1	0	0	0	0	**1**
Nuphar	1	0	0	0	0	**1**
Indeterminate	C6	20	6	6	2	**40**
Lycopodium clavatum						**10**
Pediastrum						**1**
Carbon frags.						**8**

Table 69 Pitbladdo 344cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	3	0	0	0	1	**4**
Betula	18	6	2	0	0	**26**
Alnus	38	3	11	0	0	**52**
Quercus	38	0	0	0	1	**39**
Ulmus	21	3	0	2	0	**26**
Salix	2	0	0	0	0	**2**
Coryloid	60	40	2	0	0	**102**
Ericaceae	1	0	0	0	0	**1**
Gramineae	17	1	1	7	1	**27**
Cyperaceae	0	2	0	4	0	**6**
Filipendula	1	0	0	0	0	**1**
Rumex acetosa / sella	4	0	0	0	0	**4**
Plantago lanceolata	1	0	0	0	0	**1**
Polypodium undiff.	3	0	0	0	0	**3**
Filicales undiff.	7	0	0	0	1	**8**
Dryopteris undiff.	1	0	0	0	0	**1**
Total	**215**	**55**	**16**	**13**	**4**	**303**
Nymphaea	3	0	0	0	0	**3**
Nuphar	1	0	0	0	0	**1**
Callitriche	2	0	0	0	0	**2**
Potamogeton	0	0	0	0	1	**1**
Indeterminate	C1	7	15	0	1	**24**
Lycopodium clavatum						**17**
Pediastrum						**1**
Carbon frags.						**6**

Table 70 Pitbladdo 346cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	2	1	**4**
Betula	14	10	2	0	0	**26**
Alnus	23	26	5	2	4	**60**
Quercus	14	8	0	0	0	**22**
Ulmus	9	18	3	0	0	**30**
Salix	1	0	0	0	0	**1**
Coryloid	46	60	9	1	2	**118**
Gramineae	7	4	0	2	5	**18**
Cyperaceae	0	1	0	6	0	**7**
Ranunculus type	2	0	0	0	0	**2**
Caryophyllaceae	0	0	1	0	0	**1**
Rumex acetosa / sella	4	1	0	0	0	**5**
Urtica type	1	0	0	2	0	**3**
Artemisia	1	0	0	0	0	**1**
Polypodium undiff.	1	0	0	0	0	**1**
Pteridium	1	0	0	0	0	**1**
Filicales undiff.	5	0	0	0	1	**6**
Total	**130**	**128**	**20**	**15**	**13**	**306**
Sphagnum	1	0	0	0	0	**1**
Nymphaea	1	0	0	0	0	**1**
Potamogeton	1	0	0	0	0	**1**
Indeterminate	C7	16	8	5	6	**15**
Lycopodium clavatum						**10**
Pediastrum						**1**
Carbon frags.						**3**

Table 71 Pitbladdo 348cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	0	1	0	0	1	**2**
Betula	10	6	1	0	0	**17**
Alnus	12	22	2	0	0	**42**
Quercus	29	9	0	0	0	**38**
Ulmus	31	23	0	0	0	**53**
Salix	1	0	0	0	0	**1**
Coryloid	55	46	0	0	0	**101**
Ericaceae	1	0	0	0	0	**1**
Gramineae	6	2	0	2	1	**12**
Cyperaceae	0	8	0	6	0	**14**
Filipendula	1	0	0	0	0	**1**
Rumex acetosa / sella	2	0	0	0	0	**2**
Polypodium undiff.	5	0	0	0	0	**5**
Pteridium	4	0	0	0	0	**4**
Filicales undiff.	9	1	0	0	3	**13**
Dryopteris undiff.	1	0	0	0	0	**1**
Total	**167**	**118**	**3**	**8**	**5**	**307**
Sphagnum	1	0	0	0	0	**1**
Nymphaea	2	0	0	0	0	**2**
Callitriche	1	0	0	0	0	**1**
Potamogeton	0	0	0	1	0	**1**
Indeterminate	0	24	0	0	0	**24**
Lycopodium clavatum						**18**
Carbon frags.						**9**

Table 72 Pitbladdo 350cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	0	2	**3**
Betula	12	10	0	0	0	**22**
Alnus	30	30	6	0	0	**66**
Quercus	18	6	0	4	0	**28**
Ulmus	24	17	0	0	0	**40**
Coryloid	37	64	0	2	0	**103**
Gramineae	3	2	0	1	0	**6**
Cyperaceae	1	1	0	0	0	**2**
Ranunculus type	3	1	0	0	0	**4**
Rumex acetosa / sella	8	2	0	0	0	**10**
Plantago lanceolata	2	0	0	0	0	**2**
Polypodium undiff.	5	0	0	0	0	**5**
Pteridium	2	0	0	1	0	**3**
Filicales undiff.	3	1	0	0	2	**6**
Blechnum spicant	1	0	0	0	0	**1**
Total	**150**	**134**	**6**	**8**	**4**	**301**
Nymphaea	1	0	0	1	0	**2**
Callitriche	2	0	0	0	0	**2**
Indeterminate	C6	15	5	9	2	**37**
Lycopodium clavatum						**4**
Pediastrum						**1**
Carbon frags.						**4**

Table 73 Pitbladdo 352cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Betula	19	6	3	0	1	**29**
Alnus	33	4	11	0	0	**48**
Quercus	32	1	1	0	0	**34**
Ulmus	45	2	4	1	0	**52**
Salix	1	0	0	0	0	**1**
Coryloid	55	36	1	0	0	**92**
Hedera helix	1	0	0	0	0	**1**
Ericaceae	1	0	0	0	0	**1**
Gramineae	13	0	0	6	2	**21**
Cyperaceae	1	0	0	2	0	**3**
Rumex acetosa / sella	7	0	0	0	0	**7**
Pteridium	2	0	0	0	0	**2**
Filicales undiff.	8	0	0	0	3	**11**
Dryopteris undiff.	2	0	0	0	0	**2**
Total	**220**	**49**	**20**	**9**	**6**	**304**
Nymphaea	1	0	0	0	0	**1**
Callitriche	1	0	0	0	0	**1**
Indeterminate	C2	15	10	2	0	**29**
Lycopodium clavatum						**24**
Carbon frags.						**8**

Table 74 Pitbladdo 354cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	3	0	0	0	0	**3**
Betula	10	10	0	1	0	**21**
Alnus	20	40	4	0	0	**64**
Quercus	23	2	0	1	0	**26**
Ulmus	21	17	0	1	0	**39**
Salix	3	0	0	0	0	**3**
Coryloid	51	41	0	1	0	**94**
Gramineae	12	3	0	5	2	**22**
Cyperaceae	0	4	0	2	0	**6**
Ranunculus type	2	3	0	0	0	**5**
Caryophyllaceae	1	0	0	0	0	**1**
Rosaceae undiff.	1	0	0	0	0	**1**
Rumex acetosa / sella	13	0	0	0	0	**13**
Urtica type	2	0	0	0	0	**2**
Galium type	1	0	0	0	0	**1**
Polypodium undiff.	2	0	0	0	0	**2**
Pteridium	0	0	0	0	1	**1**
Filicales undiff.	4	0	0	0	1	**5**
Total	**169**	**120**	**4**	**11**	**4**	**309**
Nymphaea	2	0	0	0	0	**2**
Indeterminate	C4	21	0	3	4	**32**
Lycopodium clavatum						**15**
Pediastrum						**2**
Carbon frags.						**8**

Table 75 Pitbladdo 356cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	2	0	0	0	0	**2**
Betula	21	4	2	1	2	**30**
Alnus	28	12	9	0	0	**49**
Quercus	46	6	0	1	1	**54**
Ulmus	38	4	0	2	0	**44**
Salix	1	0	0	0	0	**1**
Coryloid	53	38	1	0	1	**93**
Gramineae	5	0	0	3	0	**8**
Cyperaceae	0	0	0	2	1	**3**
Filipendula	1	0	0	0	0	**1**
Rumex acetosa / sella	2	0	0	0	0	**2**
Polypodium undiff.	1	0	0	0	0	**1**
Pteridium	1	0	0	0	0	**1**
Filicales undiff.	12	0	0	0	1	**13**
Total	**211**	**64**	**12**	**9**	**6**	**302**
Nymphaea	3	0	0	0	0	**3**
Callitriche	5	0	0	0	0	**5**
Indeterminate	C1	0	3	2	0	**29**
Lycopodium clavatum						**18**
Carbon frags.						**3**

Table 76 Pitbladdo 358cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	0	1	**2**
Betula	10	10	1	1	0	**22**
Alnus	25	36	2	0	1	**64**
Quercus	17	5	0	1	2	**25**
Ulmus	34	18	0	4	0	**56**
Salix	1	0	0	0	0	**1**
Coryloid	36	50	1	3	0	**90**
Gramineae	3	3	0	8	1	**15**
Cyperaceae	3	4	0	1	0	**8**
Ranunculus type	1	0	0	0	0	**1**
Rumex acetosa / sella	7	1	0	0	0	**8**
Plantago lanceolata	2	0	0	0	0	**2**
Polypodium undiff.	4	0	0	0	0	**4**
Pteridium	1	0	0	0	0	**1**
Filicales undiff.	3	1	0	0	4	**8**
Total	**148**	**128**	**4**	**18**	**9**	**307**
Sphagnum	1	0	0	0	0	**1**
Nymphaea	2	0	0	1	0	**3**
Indeterminate	C1	29	5	3	2	**40**
Lycopodium clavatum						**18**
Pediastrum						**2**
Carbon frags.						**2**

Table 77 Pitbladdo 360cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	0	0	0	0	3	**3**
Betula	12	5	3	1	0	**21**
Alnus	32	9	9	0	0	**50**
Quercus	38	6	0	1	0	**45**
Ulmus	32	8	4	4	0	**53**
Tilia	1	0	0	0	0	**1**
Coryloid	46	35	0	0	1	**82**
Hedera helix	1	0	0	0	0	**1**
Gramineae	11	2	0	5	1	**19**
Cyperaceae	2	0	0	4	0	**6**
Ranunculus type	2	0	0	0	0	**2**
Rumex acetosa / sella	4	0	0	0	0	**4**
Polypodium undiff.	3	0	0	0	0	**3**
Filicales undiff.	1	1	0	0	3	**9**
Dryopteris undiff.	2	0	0	0	1	**3**
Total	**187**	**66**	**16**	**15**	**9**	**302**
Nymphaea	2	0	0	0	0	**2**
Myriophyllum sp	1	0	0	0	0	**1**
Typha latifolia	1	0	0	0	0	**1**
Indeterminate	C3	11	4	1	1	**20**
Lycopodium clavatum						**19**
Pediastrum						**1**
Carbon frags.						**5**

Table 78 Pitbladdo 362cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	3	0	0	0	2	**5**
Betula	11	11	0	0	0	**22**
Alnus	32	33	9	0	3	**77**
Quercus	21	8	1	0	0	**30**
Ulmus	22	21	0	4	0	**47**
Salix	2	0	0	0	0	**2**
Coryloid	31	73	3	1	0	**108**
Gramineae	7	4	0	0	1	**12**
Cyperaceae	1	4	0	2	1	**8**
Filipendula	1	0	0	0	0	**1**
Rumex acetosa / sella	11	2	0	0	0	**13**
Urtica type	1	0	0	0	0	**1**
Polypodium undiff.	1	0	0	0	0	**1**
Pteridium	0	0	0	0	1	**1**
Filicales undiff.	6	1	0	0	3	**10**
Total	**150**	**157**	**13**	**7**	**11**	**338**
Sphagnum	1	0	0	0	0	**1**
Nymphaea	5	1	0	0	1	**7**
Indeterminate	C5	16	9	8	5	**43**
Lycopodium clavatum						**12**
Pediastrum						**2**
Carbon frags.						**6**

Table 79 Pitbladdo 364cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	1	4	**6**
Betula	16	6	1	1	1	**25**
Alnus	32	19	8	0	0	**59**
Quercus	46	2	0	1	0	**49**
Ulmus	34	12	0	0	0	**46**
Salix	1	0	0	0	0	**1**
Coryloid	46	41	0	0	0	**87**
Ericaceae	2	0	0	0	0	**2**
Gramineae	9	0	0	0	1	**12**
Cyperaceae	2	0	0	0	0	**2**
Rumex acetosa / sella	4	0	0	0	0	**4**
Polypodium undiff.	1	0	0	0	0	**1**
Pteridium	0	0	0	0	1	**1**
Filicales undiff.	9	0	0	0	5	**14**
Total	**203**	**80**	**9**	**3**	**12**	**309**
Nymphaea	3	0	0	0	0	**3**
Myriophyllum sp	2	0	0	0	0	**2**
Callitriche	2	0	0	0	0	**2**
Potamogeton	1	0	0	0	0	**1**
Typha latifolia	1	0	0	0	0	**1**
Indeterminate	C1	16	1	0	0	**18**
Lycopodium clavatum						**20**
Pediastrum						**1**
Carbon frags.						

Table 80 Pitbladdo 366cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	0	0	**1**
Betula	11	12	1	0	0	**24**
Alnus	30	41	1	0	2	**74**
Quercus	26	6	0	6	0	**38**
Ulmus	25	14	0	2	0	**41**
Coryloid	33	54	1	2	0	**90**
Gramineae	9	10	0	4	0	**23**
Cyperaceae	0	0	0	1	0	**1**
Ranunculus type	1	1	0	0	0	**2**
Rosaceae undiff.	0	1	0	0	0	**1**
Filipendula	0	1	0	0	0	**1**
Umbelliferae	1	0	0	0	0	**1**
Rumex acetosa / sella	6	2	0	0	0	**8**
Polypodium vulgare	4	0	0	0	0	**4**
Filicales undiff.	4	0	0	0	3	**7**
Total	**151**	**142**	**3**	**15**	**5**	**316**
Nymphaea	1	0	0	0	0	**1**
Myriophyllum spicatum	1	0	0	0	0	**1**
Potamogeton	3	1	0	0	0	**4**
Indeterminate	C3	12	0	4	0	**19**
Lycopodium clavatum						**20**
Carbon frags.						**5**

Table 81 Pitbladdo 368cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	0	2	**3**
Betula	16	6	1	1	0	**24**
Alnus	23	10	10	1	0	**44**
Quercus	41	3	0	0	0	**44**
Ulmus	35	9	1	2	0	**47**
Salix	1	0	0	0	0	**1**
Coryloid	72	36	1	0	0	**109**
Hedera helix	1	0	0	0	0	**1**
Ericaceae	2	0	0	0	0	**2**
Gramineae	3	1	0	2	2	**8**
Cyperaceae	2	0	0	3	0	**5**
Ranunculus type	2	0	0	0	0	**2**
Filipendula	1	0	0	0	0	**1**
Rumex acetosa / sella	5	0	0	0	0	**5**
Polypodium undiff.	3	0	0	0	0	**3**
Filicales undiff.	2	0	0	1	1	**4**
Dryopteris undiff.	1	0	0	0	0	**1**
Total	**211**	**65**	**13**	**10**	**5**	**304**
Nymphaea	4	0	0	2	1	**9**
Indeterminate	C4	16	9	1	0	**30**
Lycopodium clavatum						**20**
Pediastrum						**1**
Carbon frags.						

Table 82 Pitbladdo 370cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	2	0	0	0	0	**2**
Betula	17	9	0	0	1	**27**
Alnus	38	31	0	1	2	**72**
Quercus	25	9	0	1	1	**36**
Ulmus	19	17	0	3	0	**39**
Coryloid	35	45	0	1	0	**81**
Hedera helix	1	0	0	0	0	**1**
Ericaceae	1	0	0	0	0	**1**
Gramineae	4	7	0	3	3	**17**
Ranunculus type	2	0	0	0	0	**2**
Rosaceae undiff.	1	0	0	0	0	**1**
Filipendula	1	0	0	0	0	**1**
Saxifraga	1	0	0	0	0	**1**
Rumex acetosa / sella	5	1	0	1	0	**7**
Filicales undiff.	5	0	0	0	4	**9**
Total	**157**	**119**	**0**	**10**	**11**	**297**
Sphagnum	2	0	0	0	0	**2**
Nymphaea	4	0	0	0	0	**4**
Callitriche	5	1	0	0	0	**6**
Potamogeton	3	0	0	0	0	**3**
Indeterminate	C4	18	0	2	0	**24**
Lycopodium clavatum						**17**
Pediastrum						**1**
Carbon frags.						**2**

Table 83 Pitbladdo 372cm.

Taxa	Normal	Corroded	Degraded	Crumpled	Split	Total
Pinus	2	0	0	0	0	**2**
Betula	21	8	0	0	1	**30**
Alnus	28	16	18	0	0	**62**
Quercus	34	0	0	0	0	**34**
Ulmus	30	10	2	0	0	**42**
Salix	1	0	0	0	0	**1**
Coryloid	40	41	4	0	0	**85**
Gramineae	5	1	0	2	1	**9**
Cyperaceae	0	0	0	5	4	**9**
Ranunculus type	1	1	0	0	0	**2**
Rosa	2	0	0	0	0	**2**
Rumex acetosa / sella	5	0	0	0	0	**5**
Polypodium undiff.	4	0	0	0	0	**4**
Pteridium	1	0	0	0	0	**1**
Filicales undiff.	8	0	0	0	7	**15**
Total	**182**	**77**	**24**	**7**	**13**	**303**
Callitriche	2	0	0	0	0	**2**
Indeterminate	C5	16	2	0	2	**25**
Lycopodium clavatum						**11**
Pediastrum						**1**
Carbon frags.						

Table 84 Pitbladdo 374cm.

Taxa	Normal	Corroded	Degraded	Crumpled	Split	Total
Pinus	1	0	0	0	2	**3**
Betula	15	9	1	0	0	**25**
Alnus	25	35	0	0	0	**60**
Quercus	30	9	0	6	0	**45**
Ulmus	21	11	0	2	1	**35**
Tilia	1	0	0	0	0	**1**
Coryloid	42	49	0	1	0	**92**
Ericaceae	1	0	0	1	0	**2**
Gramineae	5	5	0	3	0	**13**
Filipendula	2	0	0	0	0	**2**
Saxifraga	3	0	0	0	0	**3**
Rumex acetosa / sella	6	1	0	0	0	**7**
Galium type	1	0	0	0	0	**1**
Polypodium vulgare	5	0	0	0	0	**5**
Pteridium	1	0	0	0	0	**1**
Filicales undiff.	5	0	0	0	2	**7**
Total	**164**	**119**	**1**	**13**	**5**	**302**
Sphagnum	2	0	0	0	0	**2**
Nymphaea	1	0	0	0	0	**1**
Callitriche	1	0	0	0	0	**1**
Indeterminate	C2	9	1	2	0	**14**
Lycopodium clavatum						**11**
Carbon frags.						**4**

Table 85 Pitbladdo 376cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	2	0	0	0	2	**4**
Betula	32	1	1	0	0	**34**
Alnus	17	13	11	0	1	**42**
Quercus	25	4	0	1	1	**31**
Ulmus	28	11	0	2	1	**42**
Salix	1	0	0	0	0	**1**
Coryloid	69	46	0	0	0	**115**
Ericaceae	11	0	0	0	0	**1**
Gramineae	6	4	0	6	0	**16**
Cyperaceae	1	0	0	1	0	**2**
Ranunculus type	3	0	0	0	0	**3**
Filipendula	1	0	0	0	0	**1**
Rumex acetosa / sella	3	0	0	0	0	**3**
Plantago media / major	1	0	0	0	0	**1**
Polypodium undiff.	1	0	0	0	0	**1**
Filicales undiff.	5	1	0	0	2	**8**
Dryopteris undiff.	2	0	0	0	0	**2**
Total	**208**	**80**	**12**	**10**	**7**	**307**
Nymphaea	1	0	0	0	0	**1**
Callitriche	1	0	0	0	0	**1**
Indeterminate	C3	16	1	2	0	**22**
Lycopodium clavatum						**13**
Pediastrum						**1**
Carbon frags.						**8**

Table 86 Pitbladdo 378cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	0	1	0	0	2	**3**
Betula	12	14	0	1	0	**27**
Alnus	35	41	0	1	0	**77**
Quercus	22	7	0	1	0	**30**
Ulmus	22	10	0	4	0	**36**
Salix	2	0	0	0	0	**2**
Coryloid	50	38	0	2	0	**90**
Gramineae	5	9	0	6	2	**22**
Cyperaceae	0	0	0	1	0	**1**
Caltha type	1	0	0	0	0	**1**
Ranunculus type	1	2	0	0	0	**3**
Rosaceae undiff.	2	0	0	0	0	**2**
Filipendula	1	0	0	0	0	**1**
Rumex acetosa / sella	4	1	0	0	0	**5**
Plantago media / major	1	0	0	0	0	**1**
Filicales undiff.	3	0	0	0	1	**4**
Total	**161**	**123**	**0**	**16**	**5**	**305**
Nymphaea	3	0	0	0	0	**3**
Callitriche	2	0	0	0	0	**2**
Potamogeton	0	0	0	1	0	**1**
Indeterminate	C2	11	2	4	0	**19**
Lycopodium clavatum						**12**
Carbon frags.						**6**

Table 87 Pitbladdo 380cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	2	2	0	0	1	**5**
Betula	30	8	0	1	0	**39**
Alnus	26	19	3	0	0	**48**
Quercus	30	11	0	0	1	**42**
Ulmus	34	7	0	2	0	**43**
Salix	1	0	0	0	0	**1**
Coryloid	43	42	0	0	1	**86**
Hedera helix	1	0	0	0	0	**1**
Gramineae	15	0	0	5	2	**22**
Cyperaceae	1	0	0	4	0	**6**
Rumex acetosa / sella	3	1	0	0	0	**4**
Scabiosa	1	0	0	0	0	**1**
Polypodium undiff.	3	0	0	0	0	**3**
Filicales undiff.	10	0	0	0	2	**12**
Total	**200**	**90**	**3**	**12**	**7**	**313**
Sphagnum	1	0	0	0	0	**1**
Nymphaea	2	0	0	0	0	**2**
Callitriche	3	0	0	0	0	**3**
Potamogeton	0	0	0	1	0	**1**
Indeterminate	0	15	1	2	0	**18**
Lycopodium clavatum						**17**
Pediastrum						**1**
Carbon frags.						**5**

Table 88 Pitbladdo 382cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	3	0	0	0	2	**5**
Betula	11	10	0	0	1	**22**
Alnus	26	26	1	1	1	**55**
Quercus	16	1	0	9	0	**26**
Ulmus	29	9	0	0	0	**38**
Coryloid	60	56	0	2	0	**118**
Hedera helix	1	0	0	0	0	**1**
Gramineae	3	7	0	1	0	**11**
Papaver undiff.	1	0	0	0	0	**1**
Rosaceae undiff.	3	0	0	0	0	**3**
Filipendula	3	0	0	0	0	**3**
Rumex acetosa / sella	2	0	0	0	0	**2**
Galium type	0	2	0	0	0	**2**
Polypodium undiff.	1	0	0	0	0	**1**
Filicales undiff.	6	0	0	0	10	**16**
Total	**165**	**111**	**1**	**13**	**14**	**304**
Nymphaea	1	0	0	0	0	**1**
Callitriche	3	0	0	1	0	**4**
Indeterminate	C2	15	1	1	1	**20**
Lycopodium clavatum						**18**
Carbon frags.						**2**

Table 89 Pitbladdo 384cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	2	0	0	0	2	**4**
Betula	15	2	1	1	0	**19**
Alnus	23	6	3	0	0	**32**
Quercus	32	1	0	0	0	**33**
Ulmus	41	1	0	0	0	**42**
Coryloid	96	35	1	0	1	**134**
Hedera helix	1	0	0	0	0	**1**
Gramineae	4	0	0	7	1	**12**
Cyperaceae	0	1	0	0	0	**1**
Ranunculus type	1	0	0	0	0	**1**
Filipendula	2	0	0	0	0	**2**
Rumex acetosa / sella	2	0	0	0	0	**2**
Polypodium undiff.	2	0	0	0	0	**2**
Pteridium	1	0	0	0	0	**1**
Filicales undiff.	7	0	0	0	4	**11**
Dryopteris undiff.	2	0	0	1	0	**3**
Total	**231**	**46**	**5**	**9**	**8**	**300**
Nymphaea	3	0	0	0	0	**3**
Callitriche	2	0	0	0	0	**2**
Indeterminate	C2	9	4	1	1	**17**
Lycopodium clavatum						**19**
Pediastrum						**3**
Carbon frags.						5

Table 90 Pitbladdo 386cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	0	0	0	0	3	**3**
Betula	17	7	0	0	1	**25**
Alnus	33	25	1	0	2	**61**
Quercus	23	2	0	2	1	**28**
Ulmus	28	6	0	2	0	**36**
Coryloid	69	47	1	2	0	**119**
Hedera helix	1	0	0	0	0	**1**
Gramineae	3	3	0	3	1	**10**
Cyperaceae	0	0	0	1	0	**1**
Ranunculus type	4	0	0	0	0	**4**
Rosaceae undiff.	1	0	0	0	0	**1**
Filipendula	2	0	0	0	0	**2**
Rumex acetosa / sella	1	3	0	0	0	**4**
Anagallis	1	0	0	0	0	**1**
Polypodium undiff.	3	0	0	0	0	**3**
Filicales undiff.	1	2	0	1	0	**4**
Total	**187**	**95**	**2**	**11**	**8**	**303**
Sphagnum	1	0	0	0	0	**1**
Nymphaea	1	0	0	0	0	**1**
Nuphar	1	0	0	0	0	**1**
Callitriche	2	0	0	0	0	**2**
Indeterminate	C4	9	0	1	0	**14**
Lycopodium clavatum						**17**
Pediastrum						**2**
Carbon frags.						**2**

Table 91 Pitbladdo 388cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	3	0	0	0	5	**8**
Betula	21	0	7	1	0	**29**
Alnus	29	5	2	0	1	**37**
Quercus	23	0	0	0	0	**23**
Ulmus	18	5	1	3	0	**27**
Salix	3	0	0	0	0	**3**
Coryloid	81	49	1	1	0	**132**
Gramineae	9	0	0	3	1	**12**
Cyperaceae	2	1	0	2	0	**5**
Ranunculus type	1	0	0	0	0	**1**
Rumex acetosa / sella	5	0	0	0	0	**5**
Polypodium undiff.	7	0	0	0	0	**7**
Filicales undiff.	14	0	0	0	14	**18**
Total	**216**	**60**	**11**	**10**	**21**	**307**
Sphagnum	1	0	0	0	0	**1**
Nymphaea	2	0	0	0	0	**2**
Callitriche	1	0	0	0	0	**1**
Typha latifolia	1	0	0	0	0	**1**
Indeterminate	C2	12	1	2	1	**18**
Lycopodium clavatum						**11**
Pediastrum						**3**
Carbon frags.						**7**

Table 92 Pitbladdo 390cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	0	1	**2**
Betula	20	11	0	1	0	**32**
Alnus	23	28	0	0	0	**51**
Quercus	12	4	1	2	1	**20**
Ulmus	14	7	0	1	0	**22**
Salix	3	0	0	0	0	**3**
Coryloid	71	45	3	3	0	**122**
Hedera helix	1	0	0	0	0	**1**
Gramineae	10	5	0	5	1	**21**
Cyperaceae	0	0	0	1	0	**1**
Ranunculus type	1	0	0	0	0	**1**
Chenopodiaceae	1	0	0	0	0	**1**
Rosaceae undiff.	1	0	0	0	0	**1**
Saxifraga	1	0	0	0	0	**1**
Rumex acetosa / sella	3	0	0	0	0	**3**
Polypodium vulgare	1	0	0	0	0	**1**
Filicales undiff.	9	0	0	1	8	**18**
Total	**172**	**100**	**4**	**14**	**11**	**301**
Nymphaea	1	0	0	0	0	**1**
Typha latifolia	1	0	0	0	0	**1**
Indeterminate	C1	17	0	3	0	**21**
Lycopodium clavatum						**15**
Pediastrum						**1**
Carbon frags.						**1**

Table 93 Pitbladdo 392cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	2	0	0	0	1	**3**
Betula	34	3	1	1	2	**41**
Alnus	22	5	3	0	0	**30**
Quercus	40	0	0	2	0	**42**
Ulmus	33	3	0	2	0	**38**
Salix	2	0	0	0	0	**2**
Coryloid	91	20	0	0	0	**110**
Ericaceae	1	0	0	0	0	**1**
Gramineae	7	0	0	5	1	**13**
Cyperaceae	0	0	0	2	0	**2**
Rumex acetosa / sella	2	0	0	0	0	**2**
Compositae tub.	1	0	0	0	0	**1**
Polypodium undiff.	2	0	0	0	0	**2**
Filicales undiff.	10	0	0	1	6	**17**
Dryopteris undiff.	2	0	0	0	0	**2**
Total	**249**	**31**	**4**	**13**	**10**	**306**
Nymphaea	4	0	0	0	0	**4**
Callitriche	4	0	0	0	0	**4**
Typha latifolia	1	0	0	0	0	**1**
Indeterminate	C3	6	10	5	0	**24**
Lycopodium clavatum						**19**
Pediastrum						**1**
Carbon frags.						**3**

Table 94 Pitbladdo 394cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	3	0	0	0	2	5
Betula	21	10	0	1	1	**33**
Alnus	26	26	1	0	2	**55**
Quercus	14	6	0	3	1	**24**
Ulmus	13	13	0	0	0	**26**
Salix	2	0	0	0	0	**2**
Coryloid	61	56	0	2	0	**119**
Gramineae	8	5	0	3	0	**16**
Ranunculus type	1	0	0	0	0	**1**
Rosaceae undiff.	0	1	0	0	0	**1**
Filipendula	1	0	0	0	0	**1**
Saxifraga	1	0	0	0	0	**1**
Parnassia palustris	1	0	0	0	0	**1**
Rumex acetosa / sella	3	1	0	0	0	**4**
Trientalis europaea	1	0	0	0	0	**1**
Artemisia	0	1	0	0	0	**1**
Polypodium vulgare	1	0	0	0	0	**1**
Filicales undiff.	5	0	0	0	8	**13**
Total	**162**	**119**	**1**	**9**	**14**	**305**
Nymphaea	3	0	0	0	0	**3**
Indeterminate	C2	21	0	5	1	**29**
Lycopodium clavatum						**9**
Carbon frags.						**3**

Table 95 Pitbladdo 396cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	3	0	0	0	3	**6**
Betula	38	7	0	0	0	**45**
Alnus	28	8	1	0	0	**37**
Quercus	30	8	0	1	0	**39**
Ulmus	10	6	0	0	0	**16**
Salix	1	0	0	0	0	**1**
Coryloid	81	26	0	1	0	**108**
Gramineae	11	2	0	6	2	**21**
Cyperaceae	0	0	0	4	1	**5**
Ranunculus type	2	0	0	0	0	**2**
Rumex acetosa / sella	3	0	0	0	0	**3**
Polypodium undiff.	1	0	0	0	0	**1**
Filicales undiff.	13	1	0	0	4	**18**
Total	**221**	**58**	**1**	**12**	**10**	**302**
Nymphaea	2	0	0	0	0	**2**
Callitriche	1	0	0	0	0	**1**
Potamogeton	4	0	0	0	0	**4**
Indeterminate	C2	10	1	0	1	**14**
Lycopodium clavatum						**8**
Carbon frags.						**1**

Table 96 Pitbladdo 398cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	0	0	0	0	2	**2**
Betula	19	15	0	1	1	**36**
Alnus	34	25	4	0	1	**64**
Quercus	14	6	0	6	0	**26**
Ulmus	19	5	1	0	0	**25**
Salix	3	0	0	0	0	**3**
Coryloid	64	52	1	3	1	**121**
Gramineae	10	4	0	0	1	**15**
Saxifraga	2	0	0	0	0	**2**
Rumex acetosa / sella	5	0	0	0	0	**5**
Polypodium vulgare	2	0	0	0	0	**2**
Filicales undiff.	3	1	0	0	2	**6**
Total	**175**	**108**	**6**	**10**	**8**	**307**
Nymphaea	1	0	0	0	0	**1**
Callitriche	1	0	0	3	0	**4**
Indeterminate	C2	12	1	2	0	**17**
Lycopodium clavatum						**5**
Pediastrum						**2**
Carbon frags.						**2**

Table 97 Pitbladdo 400cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	2	0	0	0	1	**3**
Betula	32	5	0	1	0	**38**
Alnus	42	4	4	0	0	**51**
Quercus	27	0	0	0	1	**28**
Ulmus	32	4	0	1	0	**37**
Salix	2	0	0	0	0	**2**
Coryloid	66	27	1	0	1	**95**
Hedera helix	1	0	0	0	0	**1**
Gramineae	13	1	0	2	2	**18**
Cyperaceae	1	0	0	6	0	**7**
Chenopodiaceae	1	0	0	0	0	**1**
Filipendula	1	0	0	0	0	**1**
Parnassia palustris	1	0	0	0	0	**1**
Rumex acetosa / sella	6	0	0	0	0	**6**
Polypodium undiff.	2	0	0	0	0	**2**
Pteridium	2	0	0	0	0	**2**
Filicales undiff.	7	0	0	0	5	**12**
Total	**238**	**41**	**5**	**10**	**10**	**305**
Nymphaea	1	0	0	2	0	**3**
Myriophyllum sp	1	1	0	0	0	**2**
Indeterminate	C5	24	2	2	0	**33**
Lycopodium clavatum						**20**
Carbon frags.						**4**

Table 98 Pitbladdo 402cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	2	1	0	1	4	**8**
Betula	23	7	1	3	1	**35**
Alnus	28	23	4	0	0	**55**
Quercus	25	4	0	10	1	**40**
Ulmus	23	9	0	5	0	**37**
Salix	2	0	0	0	0	**2**
Coryloid	37	59	0	0	0	**96**
Gramineae	8	3	0	2	1	**14**
Ranunculus type	2	1	0	0	0	**3**
Filipendula	2	0	0	0	0	**2**
Saxifraga	0	1	0	0	0	**1**
Rumex acetosa / sella	2	0	0	0	0	**2**
Polypodium vulgare	1	0	0	0	0	**1**
Filicales undiff.	3	0	0	0	5	**8**
Total	**158**	**108**	**5**	**21**	**12**	**304**
Indeterminate	C5	13	4	2	1	**25**
Lycopodium clavatum						**1**
Pediastrum						**3**
Carbon frags.						**3**

Table 99 Pitbladdo 404cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	0	3	**4**
Betula	28	3	0	2	0	**33**
Alnus	33	6	12	0	0	**51**
Quercus	24	0	0	1	0	**25**
Ulmus	37	6	1	5	0	**49**
Coryloid	64	39	1	2	0	**106**
Ericaceae	1	0	0	0	0	**1**
Gramineae	9	0	0	7	0	**16**
Cyperaceae	0	0	0	2	0	**2**
Ranunculus type	2	0	0	0	0	**2**
Rumex acetosa / sella	3	0	0	0	0	**3**
Galium type	1	0	0	0	0	**1**
Diphasiastrum	2	0	0	0	0	**2**
Polypodium undiff.	2	0	0	0	0	**2**
Filicales undiff.	6	1	0	0	2	**9**
Total	**213**	**55**	**14**	**19**	**5**	**306**
Nymphaea	4	0	0	0	0	**4**
Callitriche	1	0	0	1	0	**2**
Indeterminate	C4	12	4	1	1	**22**
Lycopodium clavatum						**20**
Pediastrum						**3**
Carbon frags.						**6**

Table 100 Pitbladdo 406cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	3	0	0	0	2	**5**
Betula	16	20	0	1	0	**37**
Alnus	21	18	5	1	0	**45**
Quercus	21	8	1	4	0	**34**
Ulmus	12	9	1	3	0	**25**
Tilia	1	0	0	0	0	**1**
Coryloid	70	47	1	2	3	**123**
Gramineae	7	5	0	2	0	**14**
Cyperaceae	0	1	0	0	0	**1**
Ranunculus type	0	1	0	0	0	**1**
Rosaceae undiff.	1	0	0	0	0	**1**
Filipendula	0	0	0	0	1	**1**
Rosa	2	0	0	0	0	**2**
Saxifraga	2	0	0	0	0	**2**
Rumex acetosa / sella	3	0	0	0	0	**3**
Trientalis europaea	1	0	0	0	0	**1**
Polypodium vulgare	0	1	0	0	0	**1**
Filicales undiff.	6	2	0	0	2	**10**
Total	**166**	**112**	**8**	**13**	**8**	**307**
Nymphaea	3	0	0	0	0	**3**
Callitriche	0	0	0	2	0	**2**
Indeterminate	0	12	5	8	1	**26**
Lycopodium clavatum						**18**
Pediastrum						**1**
Carbon frags.						**1**

Table 101 Pitbladdo 408cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	2	0	0	0	6	**8**
Betula	32	7	0	1	0	**40**
Alnus	22	7	8	0	0	**37**
Quercus	34	4	1	1	1	**41**
Ulmus	23	11	1	1	0	**37**
Salix	3	0	0	0	0	**3**
Coryloid	76	23	1	1	1	**103**
Ericaceae	2	0	0	0	0	**2**
Gramineae	7	0	0	2	0	**9**
Cyperaceae	0	0	0	3	0	**3**
Ranunculus type	4	0	0	0	0	**4**
Filipendula	1	0	0	0	0	**1**
Polypodium undiff.	5	0	0	0	0	**5**
Pteridium	0	0	0	1	0	**1**
Filicales undiff.	1	0	0	0	5	**6**
Dryopteris undiff.	3	0	0	0	0	**3**
Total	**215**	**52**	**11**	**10**	**13**	**303**
Sphagnum	1	0	0	0	0	**1**
Nymphaea	2	0	0	0	0	**2**
Callitriche	2	0	0	0	0	**2**
Potamogeton	1	0	0	1	0	**2**
Indeterminate	C1	14	7	1	2	**25**
Lycopodium clavatum						**15**
Pediastrum						**2**
Carbon frags.						**4**

Table 102 Pitbladdo 410cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	0	1	0	0	1	**2**
Betula	23	23	0	2	0	**48**
Alnus	27	25	2	2	3	**59**
Quercus	21	3	0	3	0	**27**
Ulmus	16	8	0	1	0	**25**
Salix	2	0	0	0	0	**2**
Coryloid	63	48	0	2	0	**113**
Gramineae	5	5	0	0	1	**11**
Ranunculus type	3	0	0	1	0	**4**
Rosaceae undiff.	2	0	0	0	0	**2**
Filipendula	1	0	0	0	0	**1**
Saxifraga	2	1	0	0	0	**3**
Rumex acetosa / sella	3	0	0	0	0	**3**
Polypodium vulgare	1	0	0	0	0	**1**
Filicales undiff.	4	1	0	0	1	**6**
Total	**173**	**115**	**2**	**11**	**6**	**307**
Callitriche	1	0	0	1	0	**2**
Sphagnum	1	0	0	0	0	**1**
Indeterminate	1	17	1	8	1	**28**
Lycopodium clavatum						**7**
Pediastrum						**3**
Carbon frags.						**6**

Table 103 Pitbladdo 412cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	3	0	0	2	4	**9**
Betula	41	2	0	1	0	**44**
Alnus	11	4	6	0	2	**23**
Quercus	29	1	0	0	0	**30**
Ulmus	19	5	0	0	0	**24**
Coryloid	95	40	0	1	0	**132**
Hedera helix	1	0	0	0	0	**1**
Gramineae	7	2	0	6	3	**18**
Cyperaceae	0	0	0	5	0	**5**
Ranunculus type	1	0	0	0	0	**1**
Ribes rubrum type	1	0	0	0	0	**1**
Rumex acetosa / sella	2	0	0	0	0	**2**
Filicales undiff.	8	0	0	0	5	**13**
Total	**218**	**54**	**6**	**15**	**14**	**303**
Nymphaea	1	0	0	3	4	**8**
Indeterminate	4	17	0	1	1	**23**
Lycopodium clavatum						**16**
Pediastrum						**2**
Carbon frags.						**4**

Table 104 Pitbladdo 414cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	0	0	0	0	2	**2**
Betula	38	18	1	0	0	**57**
Alnus	18	29	0	1	0	**48**
Quercus	16	2	0	2	1	**21**
Ulmus	13	6	0	0	0	**19**
Salix	3	0	0	0	0	**3**
Coryloid	60	64	3	4	0	**131**
Hedera helix	1	0	0	0	0	**1**
Gramineae	2	1	0	1	0	**4**
Ranunculus type	3	0	0	1	0	**4**
Filipendula	2	0	0	0	0	**2**
Umbelliferae	1	0	0	0	0	**1**
Rumex acetosa / sella	4	0	0	0	0	**4**
Trientalis europaea	1	0	0	0	0	**1**
Polypodium vulgare	2	0	0	0	0	**2**
Filicales undiff.	6	0	0	0	2	**8**
Total	**170**	**120**	**4**	**9**	**5**	**308**
Nymphaea	1	0	0	0	0	**1**
Callitriche	6	0	0	1	0	**7**
Indeterminate	1	20	4	4	1	**30**
Lycopodium clavatum						**4**
Pediastrum						**4**
Carbon frags.						**1**

Table 105 Pitbladdo 416cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	5	0	0	2	2	**9**
Betula	32	5	1	1	0	**39**
Alnus	21	6	2	0	0	**29**
Quercus	24	2	0	0	0	**26**
Ulmus	7	0	0	1	1	**29**
Coryloid	90	36	0	0	1	**127**
Ericaceae	1	0	0	0	0	**1**
Gramineae	7	3	0	5	1	**16**
Cyperaceae	0	0	0	6	0	**6**
Filipendula	2	0	0	0	0	**2**
Rumex acetosa / sella	7	0	0	0	0	**7**
Anagallis	1	0	0	0	0	**1**
Galium type	2	0	0	0	0	**2**
Aster type	1	0	0	0	0	**1**
Filicales undiff.	10	0	0	1	3	**14**
Total	**210**	**52**	**3**	**16**	**8**	**309**
Callitriche	3	0	0	1	0	**4**
Potamogeton	0	0	0	1	0	**1**
Indeterminate	C6	17	0	1	0	**24**
Lycopodium clavatum						**10**
Pediastrum						**2**
Carbon frags.						**2**

Table 106 Pitbladdo 418cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	0	1	**2**
Betula	30	18	1	2	0	**51**
Alnus	19	13	4	0	0	**36**
Quercus	23	4	1	2	1	**31**
Ulmus	18	9	1	0	0	**28**
Salix	1	0	0	0	0	**1**
Coryloid	79	56	5	2	1	**143**
Hedera helix	2	0	0	0	0	**2**
Ericaceae	1	0	0	0	0	**1**
Gramineae	6	3	1	1	0	**11**
Cyperaceae	1	1	0	0	0	**2**
Ranunculus type	0	1	0	0	0	**1**
Filipendula	1	0	0	0	0	**1**
Saxifraga	1	0	0	0	0	**1**
Rumex acetosa / sella	3	0	0	0	0	**3**
Trientalis europaea	2	0	0	0	0	**2**
Polypodium vulgare	1	0	0	0	0	**1**
Filicales undiff.	5	1	0	0	0	**6**
Total	**194**	**106**	**13**	**7**	**3**	**323**
Nymphaea	1	0	0	0	0	**1**
Callitriche	3	0	0	3	0	**6**
Indeterminate	2	11	5	6	1	**25**
Lycopodium clavatum						**5**
Pediastrum						**4**
Carbon frags.						**3**

Table 107 Pitbladdo 420cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	5	0	0	0	6	**11**
Betula	37	8	1	0	1	**47**
Alnus	5	1	0	0	1	**7**
Quercus	24	5	0	0	0	**29**
Ulmus	19	5	1	3	0	**28**
Salix	3	0	0	0	0	**3**
Coryloid	108	32	1	0	0	**141**
Gramineae	5	2	0	4	1	**12**
Cyperaceae	0	0	0	2	0	**2**
Ranunculus type	1	1	0	0	0	**2**
Filipendula	2	0	0	0	0	**2**
Rumex acetosa / sella	4	0	0	0	0	**4**
Compositae lig.	1	0	0	0	0	**1**
Pteridium	1	0	0	0	0	**1**
Filicales undiff.	7	1	0	0	5	**13**
Dryopteris undiff.	1	0	0	0	0	**1**
Total	**223**	**55**	**3**	**9**	**14**	**304**
Callitriche	1	0	0	1	0	**2**
Indeterminate	3	5	0	2	0	**10**
Lycopodium clavatum						**14**
Pediastrum						**3**
Carbon frags.						**3**

Table 108 Pitbladdo 422cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	2	0	0	0	2	**4**
Betula	26	15	2	0	0	**43**
Alnus	14	12	0	0	0	**26**
Quercus	13	3	0	3	0	**19**
Ulmus	12	8	0	0	0	**20**
Salix	4	0	0	0	0	**4**
Coryloid	90	59	0	2	2	**153**
Hedera helix	1	0	0	0	0	**1**
Gramineae	9	1	0	3	1	**14**
Cyperaceae	0	0	0	1	0	**1**
Ranunculus type	1	0	0	0	0	**1**
Chenopodiaceae	1	0	0	0	0	**1**
Rosaceae undiff.	1	0	0	0	0	**1**
Saxifraga	1	0	0	0	0	**1**
Rumex acetosa / sella	6	0	0	0	0	**6**
Artemisia	1	0	0	0	0	**1**
Poypodium vulgare	1	0	0	0	0	**1**
Filicales undiff.	5	1	0	0	4	**10**
Total	**188**	**99**	**2**	**9**	**9**	**307**
Nymphaea	1	0	0	0	0	**1**
Callitriche	1	0	0	0	0	**1**
Indeterminate	4	14	0	3	0	**21**
Lycopodium clavatum						**5**
Pediastrum						**8**
Carbon frags.						**5**

Table 109 Pitbladdo 424cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	0	2	**3**
Betula	39	8	0	0	0	**45**
Alnus	9	2	2	0	0	**13**
Quercus	16	0	0	0	0	**16**
Ulmus	17	3	0	2	0	**22**
Salix	3	0	0	0	0	**3**
Coryloid	122	44	0	3	0	**169**
Ericaceae	1	0	0	0	0	**1**
Gramineae	6	1	0	0	0	**7**
Cyperaceae	0	0	0	7	1	**8**
Rumex acetosa / sella	3	1	0	0	0	**4**
Polypodium undiff.	1	0	0	0	0	**1**
Pteridium	1	0	0	0	0	**1**
Filicales undiff.	3	0	0	0	6	**9**
Total	**222**	**59**	**2**	**12**	**9**	**302**
Sphagnum	1	0	0	0	0	**1**
Nymphaea	2	0	0	0	0	**2**
Callitriche	2	0	0	0	0	**2**
Potamogeton	1	0	0	0	0	**1**
Indeterminate	5	24	0	1	0	**30**
Lycopodium clavatum						**13**
Pediastrum						**6**
Carbon frags.						**2**

Table 110 Pitbladdo 426cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	0	0	0	0	2	**2**
Betula	26	8	1	0	0	**35**
Alnus	13	10	2	0	0	**25**
Quercus	16	4	0	3	0	**23**
Ulmus	9	1	0	1	0	**11**
Coryloid	119	61	2	3	0	**185**
Gramineae	6	0	0	1	0	**7**
Caltha type	1	0	0	0	0	**1**
Ranunculus type	3	0	0	0	0	**3**
Filipendula	2	0	0	0	0	**2**
Saxifraga	2	0	0	0	0	**2**
Rumex acetosa / sella	6	1	0	0	0	**7**
Anthemis type	2	0	0	0	0	**2**
Polypodium vulgare	2	0	0	0	0	**2**
Filicales undiff.	3	0	0	0	2	**5**
Total	**210**	**85**	**5**	**8**	**4**	**312**
Callitriche	2	0	0	0	0	**2**
Sphagnum	2	0	0	0	0	**2**
Indeterminate	3	10	0	1	0	**14**
Lycopodium clavatum						**1**
Pediastrum						**4**
Carbon frags.						**2**

Table 111 Pitbladdo 428cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	10	0	0	0	2	**12**
Betula	29	3	0	0	0	**32**
Alnus	4	0	0	0	0	**4**
Quercus	21	1	0	0	0	**22**
Ulmus	23	7	0	4	0	**34**
Salix	6	0	0	0	0	**6**
Coryloid	125	39	0	0	2	**166**
Gramineae	8	0	0	4	0	**12**
Cyperaceae	0	0	0	2	0	**2**
Ranunculus type	1	0	0	0	0	**1**
Filipendula	2	0	0	0	0	**2**
Rumex acetosa / sella	1	0	0	0	0	**1**
Polypodium undiff.	2	0	0	0	0	**2**
Pteridium	1	0	0	0	0	**1**
Filicales undiff.	3	0	0	0	3	**6**
Dryopteris undiff.	1	0	0	0	0	**1**
Total	**237**	**50**	**0**	**10**	**7**	**304**
Callitriche	2	0	0	0	0	**2**
Potamogeton	2	0	0	0	0	**2**
Indeterminate	C2	11	0	1	1	**15**
Lycopodium clavatum						**12**
Pediastrum						**7**
Carbon frags.						**1**

Table 112 Pitbladdo 430cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	0	3	**4**
Betula	35	19	1	0	0	**55**
Alnus	4	4	0	0	1	**9**
Quercus	10	2	1	1	0	**14**
Ulmus	10	5	0	0	1	**16**
Salix	1	0	0	0	0	**1**
Coryloid	129	71	0	0	0	**200**
Gramineae	7	2	0	2	0	**11**
Rosaceae undiff.	1	0	0	0	0	**1**
Rumex acetosa / sella	3	0	0	0	0	**3**
Hypericum elodes	1	0	0	0	0	**1**
Filicales undiff.	4	2	0	0	1	**7**
Total	**206**	**105**	**2**	**3**	**6**	**322**
Callitriche	3	0	0	4	0	**7**
Indeterminate	1	16	2	3	2	**24**
Lycopodium clavatum						**5**
Pediastrum						**10**
Carbon frags.						**6**

Table 113 Pitbladdo 432cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	4	0	0	1	6	**11**
Betula	40	8	0	1	0	**49**
Alnus	2	1	0	0	0	**3**
Quercus	13	1	0	0	0	**14**
Ulmus	20	4	0	2	1	**27**
Salix	5	0	0	0	0	**5**
Coryloid	117	44	0	0	2	**163**
Gramineae	6	2	0	3	0	**11**
Cyperaceae	0	1	0	0	0	**1**
Ranunculus type	1	0	0	0	0	**1**
Filipendula	1	0	0	0	0	**1**
Rumex acetosa / sella	3	0	0	0	0	**3**
Filicales undiff.	5	1	0	0	5	**11**
Total	**217**	**62**	**0**	**7**	**14**	**300**
Nymphaea	1	0	0	0	0	**1**
Callitriche	1	0	0	0	0	**1**
Potamogeton	1	0	0	0	0	**1**
Indeterminate	0	10	0	0	2	**12**
Lycopodium clavatum						**10**
Pediastrum						**4**
Carbon frags.						**1**

Table 114 Pitbladdo 434cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	0	0	0	1	4	5
Betula	27	29	1	2	1	**60**
Alnus	4	2	0	0	0	**6**
Quercus	19	2	0	8	1	**30**
Ulmus	9	6	0	0	0	**15**
Salix	2	0	0	0	0	**2**
Coryloid	142	46	1	3	1	**193**
Gramineae	7	2	0	2	1	**12**
Cyperaceae	0	0	0	2	0	**2**
Ranunculus type	2	1	0	0	0	**3**
Rosaceae undiff.	2	1	0	0	0	**3**
Filipendula	1	0	0	0	0	**1**
Saxifraga	1	1	0	0	0	**2**
Rumex acetosa / sella	4	0	0	0	0	**4**
Polypodium vulgare	2	0	0	0	0	**2**
Filicales undiff.	1	2	0	0	3	**6**
Total	**223**	**92**	**2**	**18**	**11**	**346**
Callitriche	1	0	0	0	0	**1**
Indeterminate	2	18	1	7	1	**29**
Lycopodium clavatum						**9**
Pediastrum						**3**
Carbon frags.						**6**

Table 115 Pitbladdo 436cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	5	0	0	0	4	**9**
Betula	43	5	0	2	0	**50**
Quercus	20	0	0	0	0	**20**
Ulmus	18	1	0	1	1	**21**
Salix	1	0	0	0	0	**1**
Coryloid	141	24	0	0	0	**165**
Gramineae	9	3	0	0	2	**14**
Cyperaceae	0	0	0	1	0	**1**
Ranunculus type	1	0	0	0	0	**1**
Filipendula	1	0	0	0	0	**1**
Rumex acetosa / sella	5	0	0	0	0	**5**
Filicales undiff.	11	0	0	0	4	**15**
Total	**255**	**33**	**0**	**4**	**11**	**303**
Nymphaea	0	0	0	1	0	**1**
Callitriche	2	0	0	0	0	**2**
Indeterminate	C1	16	0	0	0	**17**
Lycopodium clavatum						**7**
Pediastrum						**16**

Table 116 Pitbladdo 440cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	0	6	**7**
Betula	31	4	0	2	1	**38**
Quercus	17	0	0	0	0	**17**
Ulmus	7	1	1	1	0	**10**
Salix	3	0	0	0	0	**3**
Coryloid	149	32	1	4	1	**187**
Ericaceae	1	0	0	0	0	**1**
Gramineae	9	0	0	6	0	**15**
Cyperaceae	1	2	0	10	1	**14**
Rumex acetosa / sella	1	0	0	0	0	**1**
Polypodium undiff.	1	0	0	0	0	**1**
Filicales undiff.	6	0	0	0	2	**8**
Dryopteris undiff.	1	0	0	0	0	**1**
Total	**228**	**39**	**2**	**23**	**11**	**303**
Callitriche	3	0	0	1	0	**4**
Indeterminate	C5	10	4	2	0	**21**
Lycopodium clavatum						**8**
Pediastrum						**16**
Carbon frags.						**1**

Table 117 Pitbladdo 444cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	5	0	0	1	3	**9**
Betula	55	5	0	0	1	**61**
Quercus	18	0	0	0	0	**18**
Ulmus	14	3	0	0	0	**17**
Salix	1	0	0	0	0	**1**
Coryloid	140	24	0	0	0	**164**
Hedera helix	1	0	0	0	0	**1**
Gramineae	14	1	0	1	2	**18**
Cyperaceae	1	0	0	3	0	**4**
Filipendula	1	0	0	0	0	**1**
Rumex acetosa / sella	2	0	0	0	0	**2**
Filicales undiff.	6	0	0	0	4	**10**
Total	**258**	**33**	**0**	**5**	**10**	**306**
Nymphaea	0	0	0	1	0	**1**
Callitriche	2	0	0	1	0	**3**
Indeterminate	C1	14	0	0	0	**15**
Lycopodium clavatum						**11**
Pediastrum						9

Table 118 Pitbladdo 448cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	8	0	0	0	4	**12**
Betula	35	5	2	0	6	**48**
Quercus	16	2	0	0	0	**18**
Ulmus	18	4	0	3	0	**25**
Salix	1	0	0	0	0	**1**
Coryloid	119	28	1	2	1	**151**
Hedera helix	1	0	0	0	0	**1**
Gramineae	8	0	1	4	1	**14**
Cyperaceae	3	0	0	7	0	**10**
Ranunculus type	2	0	0	0	0	**2**
Filipendula	0	1	0	0	0	**1**
Rumex acetosa / sella	2	0	0	0	0	**2**
Plantago media / major	1	0	0	0	0	**1**
Polypodium undiff.	1	0	0	0	0	**1**
Filicales undiff.	6	0	0	0	8	**14**
Dryopteris undiff.	0	0	0	0	1	**1**
Total	**221**	**40**	**4**	**16**	**21**	**302**
Nymphaea	1	0	0	0	0	**1**
Callitriche	2	0	0	0	0	**2**
Typha latifolia	1	0	0	0	0	**1**
Indeterminate	C4	17	2	0	0	**23**
Lycopodium clavatum						**7**
Pediastrum						**10**

Table 119 Pitbladdo 456cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	4	0	0	0	4	**8**
Betula	36	5	1	0	0	**42**
Alnus	0	1	0	0	0	**1**
Quercus	12	0	0	0	0	**12**
Ulmus	20	5	0	1	0	**25**
Salix	4	0	0	0	0	**4**
Coryloid	134	25	1	1	1	**162**
Gramineae	13	2	0	0	1	**16**
Cyperaceae	1	0	0	12	1	**14**
Ranunculus type	2	1	0	0	0	**3**
Mercurialis perennis	1	0	0	0	0	**1**
Rumex acetosa / sella	2	0	0	0	0	**2**
Polypodium undiff.	1	0	0	0	0	**1**
Filicales undiff.	11	0	0	0	5	**16**
Total	**241**	**39**	**2**	**14**	**12**	**307**
Callitriche	1	0	0	0	0	**1**
Indeterminate	C2	17	0	1	0	**20**
Lycopodium clavatum						**8**
Pediastrum						**14**

Table 120 Pitbladdo 464cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	4	0	0	0	6	**10**
Betula	62	10	0	3	1	**76**
Alnus	1	0	0	0	0	**1**
Quercus	8	0	0	0	0	**8**
Ulmus	15	3	0	0	0	**18**
Salix	2	0	0	0	0	**2**
Coryloid	100	34	0	3	1	**138**
Ericaceae	1	0	0	0	0	**1**
Gramineae	14	1	0	3	2	**20**
Cyperaceae	0	0	0	1	0	**1**
Ranunculus type	2	0	0	0	2	**4**
Rumex acetosa / sella	3	0	0	0	0	**3**
Filicales undiff.	12	0	0	0	6	**18**
Dryopteris undiff.	1	0	0	0	0	**1**
Total	**225**	**48**	**0**	**10**	**18**	**301**
Nymphaea	2	0	0	0	0	**2**
Myriophyllum sp	1	0	0	0	0	**1**
Callitriche	2	0	0	0	0	**2**
Potamogeton	4	0	0	0	0	**4**
Indeterminate	C5	20	0	1	0	**26**
Lycopodium clavatum						**11**
Pediastrum						**7**
Carbon frags.						**2**

Table 121 Pitbladdo 472cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	5	0	0	1	3	**9**
Betula	113	8	4	1	0	**126**
Quercus	1	0	0	0	0	**1**
Ulmus	1	0	0	0	0	**1**
Salix	7	0	0	0	0	**7**
Coryloid	62	16	1	1	1	**81**
Gramineae	5	0	0	9	3	**17**
Cyperaceae	0	0	0	0	1	**1**
Filipendula	1	0	0	0	0	**1**
Taraxacum	1	0	0	0	0	**1**
Polypodium undiff.	1	0	0	0	0	**1**
Pteridium	1	0	0	0	0	**1**
Filicales	33	1	0	1	23	**58**
Total	**231**	**25**	**5**	**13**	**31**	**305**
Sphagnum	1	0	0	0	0	**1**
Nymphaea	1	0	0	0	0	**1**
Myriophyllum sp	1	0	0	0	0	**1**
Callitriche	1	0	0	0	0	**1**
Typha latifolia	1	0	0	0	0	**1**
Indeterminate	6	18	0	4	1	**29**
Lycopodium clavatum						**21**
Pediastrum						**3**
Carbon frags.						**5**

Table 122 Pitbladdo 480cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	14	0	1	0	5	**20**
Betula	47	0	0	7	0	**54**
Salix	5	0	0	0	0	**5**
Gramineae	3	0	0	3	4	**10**
Cyperaceae	1	0	0	0	0	**1**
Filipendula	1	0	0	0	0	**1**
Artemisia	1	0	0	0	0	**1**
Taraxacum	1	0	0	0	0	**1**
Polypodium undiff.	1	0	0	0	0	**1**
Filicales undiff.	20	10	0	0	0	**30**
Total	**94**	**10**	**1**	**10**	**9**	**124**
Sphagnum	1	0	0	0	0	**1**
Callitriche	1	0	0	0	0	**1**
Typha latifolia	1	0	0	0	0	**1**
Indeterminate	0	0	0	0	1	**1**
Lycopodium clavatum						**300**
Pediastrum						**1**
Carbon frags.						**3**

Table 123 Pitbladdo 488cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	5	0	0	5	16	**26**
Betula	0	1	0	0	0	**1**
Ulmus	3	0	0	0	0	**3**
Tilia	1	0	0	0	0	**1**
Coryloid	2	0	0	0	0	**2**
Gramineae	0	0	0	3	0	**3**
Cyperaceae	0	0	0	1	0	**1**
Rumex acetosa / sella	1	0	0	0	0	**1**
Artemisia	1	0	0	0	0	**1**
Total	**13**	**1**	**0**	**9**	**16**	**39**
Sphagnum	3	0	0	0	0	**3**
Typha latifolia	1	0	0	0	0	**1**
Lycopodium clavatum						**300**
Carbon frags.						**12**

Methvern Count Data.

Table 1 Methvern 16cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	8	0	0	0	0	**8**
Betula	31	1	0	0	2	**34**
Alnus	44	0	0	0	3	**47**
Ulmus	1	0	0	0	0	**1**
Coryloid	45	1	0	1	2	**49**
Ericaceae	45	3	0	2	0	**50**
Gramineae	34	9	0	16	6	**65**
Cereal type	2	0	0	0	0	**2**
Cyperaceae	2	3	0	2	0	**7**
Ranunculus type	3	1	0	0	0	**4**
Papaver rhoeas	2	0	0	0	0	**2**
Rosaceae undiff.	1	0	0	1	0	**2**
Filipendula	6	0	0	0	0	**6**
Sedum type	1	0	0	0	0	**1**
Rumex acetosa / sella	2	0	0	0	0	**2**
Urtica type	2	0	0	0	0	**2**
Plantago lanceolata	5	0	0	3	1	**9**
Plantago media / major	1	0	0	0	0	**1**
Compositae lig.	1	0	0	0	0	**1**
Taraxacum	1	0	0	0	0	**1**
Artemisia	1	0	0	0	0	**1**
Pteridium	11	0	0	0	0	**11**
Filicales undiff.	2	0	0	0	1	**3**
Total	**251**	**18**	**0**	**25**	**15**	**309**
Indeterminate	C6	4	0	3	2	**15**
Sphagnum						**344**
Lycopodium clavatum						**47**
Tilletia sphagni						**8**
Carbon frags.						**4**

Table 2 Methvern 32cm.

Taxa	Normal	Corroded	Degraded	Crumpled	Split	Total
Pinus	1	0	0	0	1	**2**
Betula	34	2	0	1	4	**41**
Alnus	53	2	0	1	1	**55**
Quercus	5	0	0	1	0	**6**
Ulmus	1	0	0	0	0	**1**
Salix	1	0	0	0	0	**1**
Coryloid	41	6	0	4	5	**56**
Ericaceae	35	6	0	1	0	**42**
Gramineae	30	9	0	13	6	**58**
Cereal type	1	0	0	0	0	**1**
Cyperaceae	2	6	0	9	0	**17**
Ranunculus type	1	0	0	0	0	**1**
Rosaceae undiff.	2	0	0	0	0	**2**
Filipendula	1	0	0	0	0	**1**
Rumex acetosa / sella	3	0	0	0	2	**5**
Plantago lanceolata	4	0	0	0	0	**4**
Galium type	1	0	0	0	0	**1**
Compositae lig.	1	0	0	0	0	**1**
Taraxacum	2	0	0	0	0	**2**
Pteridium	12	1	0	1	0	**12**
Filicales undiff.	1	0	0	0	0	**1**
Total	**232**	**32**	**0**	**31**	**19**	**310**
Indeterminate	C5	1	0	11	10	**27**
Sphagum						**199**
Lycopodium clavatum						**130**
Elodea sp.						**6**
Tilletia sphagni						**4**

Table 3 Methvern 48cm.

Taxa	Normal	Corroded	Degraded	Crumpled	Split	Total
Pinus	3	0	0	1	0	**4**
Betula	49	3	0	5	4	**61**
Alnus	32	3	0	2	0	**37**
Quercus	2	1	0	0	0	**3**
Coryloid	57	5	0	0	1	**63**
Ericaceae	43	4	0	4	0	**51**
Gramineae	16	26	1	7	2	**52**
Cyperaceae	0	1	0	2	0	**3**
Ranunculus type	2	1	0	0	0	**3**
Papaver rhoeas	1	0	0	0	0	**1**
Rumex acetosa / sella	4	1	0	1	0	**6**
Urtica type	1	0	0	1	0	**2**
Plantago lanceolata	1	0	0	1	0	**2**
Polypodium undiff.	3	0	0	0	0	**3**
Pteridium	8	0	1	1	0	**10**
Filicales undiff.	2	0	0	0	1	**3**
Total	**224**	**45**	**2**	**25**	**8**	**304**
Indeterminate	C4	10	0	7	2	**23**
Sphagnum						**1626**
Lycopodium clavatum						**322**
Tilletia sphagni						**5**
Carbon frags.						**21**

Table 4 Methvern 64cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	0	1	**2**
Betula	32	1	0	1	1	**35**
Alnus	31	3	0	1	1	**32**
Quercus	1	0	0	0	0	**1**
Coryloid	68	5	0	5	0	**78**
Ericaceae	69	5	0	1	0	**75**
Gramineae	21	22	0	2	4	**49**
Cyperaceae	3	0	0	0	0	**3**
Ranunculus type	6	1	0	0	0	**7**
Papaver dubium	1	0	0	0	0	**1**
Rosaceae undiff.	1	0	0	0	0	**1**
Filipendula	1	0	0	0	0	**1**
Rumex acetosa / sella	6	1	0	0	0	**7**
Plantago lanceolata	2	0	0	0	0	**2**
Pteridium	6	1	0	0	0	**7**
Polypodium undiff.	1	0	0	0	0	**1**
Polypodium vulgare	1	0	0	0	0	**1**
Filicales undiff.	2	0	0	0	0	**2**
Total	**253**	**39**	**0**	**10**	7	**305**
Indeterminate	C2	4	1	3	2	**12**
Sphagnum						**1127**
Lycopodium clavatum						**329**
Carbon frags.						**34**

Table 5 Methvern 80cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	0	1	**2**
Betula	69	1	1	1	3	**75**
Alnus	49	3	0	1	3	**56**
Quercus	5	0	0	0	0	**5**
Ulmus	0	0	0	2	0	**2**
Coryloid	45	3	0	3	2	**53**
Ericaceae	92	3	0	0	0	**95**
Gramineae	8	4	0	8	2	**22**
Cereal type	0	0	0	0	1	**1**
Cyperaceae	2	2	0	4	0	**8**
Papaver undiff.	1	0	0	0	0	**1**
Filipendula	1	0	0	0	0	**1**
Saxifraga	1	0	0	0	0	**1**
Rumex acetosa / sella	13	0	0	3	1	**17**
Urtica type	1	0	0	0	0	**1**
Trientalis europaea	1	0	0	0	0	**1**
Plantago lanceolata	5	0	0	1	0	**6**
Plantago media / major	1	0	0	0	0	**1**
Pteridium	3	0	0	0	2	**5**
Polypodium undiff.	3	0	0	0	0	**3**
Total	**301**	**16**	**1**	**23**	**15**	**356**
Indeterminate	C4	3	0	5	4	**16**
Sphagnum						**59**
Lycopodium clavatum						**104**
Carbon frags.						**10**

Table 6 Methvern 96cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Betula	61	3	0	4	3	**71**
Alnus	45	0	0	0	2	**47**
Quercus	1	0	0	0	0	**1**
Ulmus	1	0	0	0	0	**1**
Coryloid	32	0	0	1	0	**33**
Ericaceae	77	9	0	2	5	**93**
Gramineae	13	12	0	3	5	**33**
Cyperaceae	3	0	0	1	0	**4**
Ranunculus type	4	0	0	0	0	**4**
Rosaceae undiff.	1	0	0	0	0	**1**
Rumex acetosa / sella	10	0	0	0	0	**10**
Urtica type	1	0	0	0	0	**1**
Plantago lanceolata	1	0	0	0	0	**1**
Compositae	1	0	0	0	0	**1**
Pteridium	3	0	0	0	0	**3**
Filicales	4	0	0	0	0	**4**
Total	**258**	**24**	**0**	**11**	**15**	**308**
Indeterminate	C2	2	2	3	4	**13**
Sphagnum						**680**
Lycopodium clavatum						**195**
Tilletia sphagni						**1**
Carbon frags.						7

Table 7 Methvern 112cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	0	1	**2**
Betula	53	1	0	1	5	**60**
Alnus	47	6	0	0	1	**54**
Quercus	1	1	0	0	0	**2**
Ulmus	0	0	0	1	0	**1**
Coryloid	52	5	0	1	4	**62**
Ericaceae	83	10	0	10	0	**103**
Gramineae	25	51	0	12	12	**100**
Cyperaceae	11	34	0	16	0	**61**
Ranunculus type	2	0	0	0	1	**3**
Filipendula	1	0	0	0	0	**1**
Rumex acetosa / sella	1	2	0	0	0	**3**
Urtica type	1	0	0	1	0	**2**
Plantago lanceolata	8	1	0	1	0	**10**
Plantago media / major	2	1	0	0	0	**3**
Pteridium	10	0	0	0	1	**11**
Filicales undiff.	1	0	0	0	0	**1**
Total	**299**	**112**	**0**	**43**	**25**	**479**
Indeterminate	C2	18	0	10	5	**35**
Sphagnum						**132**
Lycopodium clavatum						**58**
Carbon frags.						**122**

Table 8 Methvern 128cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	0	1	**2**
Betula	37	0	0	4	0	**41**
Alnus	47	0	0	1	5	**53**
Quercus	2	0	0	0	0	**2**
Ulmus	1	0	0	1	0	**2**
Coryloid	101	2	0	5	0	**108**
Ericaceae	98	8	0	11	0	**117**
Gramineae	36	11	0	37	7	**91**
Cereal type	1	0	0	0	0	**1**
Cyperaceae	2	5	0	12	0	**19**
Papaver undiff.	1	0	0	0	0	**1**
Rosaceae undiff.	1	0	0	0	0	**1**
Filipendula	4	1	0	0	1	**6**
Parnassia palustris	1	0	0	0	0	**1**
Drosera undiff.	1	0	0	0	0	**1**
Umbelliferae	1	0	0	0	0	**1**
Rumex acetosa / sella	3	0	0	0	0	**3**
Plantago lanceolata	11	1	0	3	1	**16**
Compositae lig.	1	0	0	0	0	**1**
Pteridium	12	0	0	1	0	**13**
Filicales undiff.	8	0	0	0	0	**8**
Total	**370**	**28**	**0**	75	15	**488**
Indeterminate	C10	5	0	7	3	**25**
Sphagnum						**246**
Lycopodium clavatum						**68**
Tilletia sphagni						**1**
Carbon frags.						**114**

Table 9 Methvern 144cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	4	0	0	0	0	**4**
Betula	33	1	0	3	1	**38**
Alnus	52	1	0	1	1	**55**
Quercus	9	0	0	3	0	**12**
Coryloid	101	1	0	1	4	**107**
Ericaceae	12	2	0	1	0	**15**
Gramineae	11	13	0	8	0	**32**
Cyperaceae	3	8	0	7	0	**18**
Ranunculus type	2	0	0	0	1	**3**
Umbelliferae	1	0	0	0	0	**1**
Rumex acetosa / sella	3	0	0	0	1	**4**
Urtica type	1	0	0	1	0	**2**
Plantago lanceolata	4	1	0	1	0	**6**
Compositae lig.	2	0	0	0	0	**2**
Pteridium	2	0	1	0	0	**3**
Filicales undiff.	1	0	0	0	0	**1**
Total	**241**	**27**	**1**	**26**	**8**	**303**
Indeterminate	C1	2	0	0	2	**5**
Sphagnum						**118**
Lycopodium clavatum						**29**
Tilletia sphagni						**8**
Carbon frags.						**9**

Table 10 Methvern 160cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Betula	26	1	0	0	1	**28**
Alnus	61	3	0	0	7	**71**
Quercus	1	0	0	0	0	**1**
Ulmus	1	0	0	0	0	**1**
Coryloid	90	1	0	3	4	**98**
Ericaceae	17	1	0	0	0	**18**
Gramineae	6	21	0	6	3	**35**
Cyperaceae	9	15	1	11	0	**36**
Chenopodiaceae	1	0	0	0	0	**1**
Rosaceae undiff.	1	0	0	0	0	**1**
Rumex acetosa / sella	2	0	0	1	0	**3**
Urtica type	1	0	0	0	0	**1**
Plantago lanceolata	3	0	0	0	0	**3**
Polypodium undiff.	1	0	0	0	0	**1**
Pteridium	9	1	0	1	0	**11**
Filicales undiff.	2	0	0	0	0	**2**
Total	**231**	**43**	**1**	**22**	**15**	**311**
Indeterminate	C3	4	0	4	4	**15**
Sphagnum						**26**
Lycopodium clavatum						**42**
Carbon frags.						**37**

Table 11 Methvern 164cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	0	0	0	0	1	**1**
Betula	26	0	0	2	1	**29**
Alnus	70	1	0	0	6	**77**
Quercus	3	0	0	1	0	**4**
Ulmus	1	0	0	1	0	**2**
Coryloid	116	1	0	6	4	**127**
Ericaceae	4	2	0	2	0	**8**
Gramineae	9	7	0	13	4	**33**
Cyperaceae	0	0	0	5	0	**5**
Ranunculus type	3	0	0	0	0	**3**
Saxifraga	1	0	0	0	0	**1**
Rumex acetosa / sella	3	0	0	1	0	**4**
Urtica type	3	0	0	1	0	**4**
Prunella vulgaris	1	0	0	0	0	**1**
Plantago lanceolata	4	0	0	0	0	**4**
Polypodium undiff.	1	0	0	0	0	**1**
Polypodium vulgare	1	0	0	0	0	**1**
Filicales undiff.	5	0	0	0	0	**5**
Total	**251**	**11**	**0**	**32**	**16**	**310**
Indeterminate	C2	0	0	6	0	**8**
Sphagnum						**8**
Lycopodium clavatum						**48**
Carbon frags.						**28**

Table 12 Methvern 168cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	0	1	0	0	4	**5**
Betula	36	1	0	0	4	**41**
Alnus	66	0	0	1	3	**70**
Quercus	1	0	0	0	1	**2**
Coryloid	100	1	0	4	3	**108**
Ericaceae	16	0	0	0	0	**16**
Gramineae	13	3	0	9	0	**25**
Cyperaceae	0	0	0	12	0	**12**
Ranunculus type	3	0	0	0	0	**3**
Filipendula	2	0	0	0	0	**2**
Saxifraga	1	0	0	0	0	**1**
Drosera rotundifolia	1	0	0	0	0	**1**
Rumex acetosa / sella	3	0	0	2	1	**6**
Urtica type	2	0	0	0	0	**2**
Plantago lanceolata	1	0	0	0	0	**1**
Polypodium undiff.	1	0	0	0	0	**1**
Polypodium vulgare	1	0	0	0	0	**1**
Pteridium	3	0	0	0	0	**3**
Filicales undiff.	5	0	0	0	1	**6**
Total	**255**	**6**	**0**	**28**	**17**	**306**
Indeterminate	C2	3	0	7	4	**16**
Sphagnum						**28**
Lycopodium clavatum						**133**
Tilletia sphagni						**2**
Carbon frags.						**53**

Table 13 Methvern 172cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	0	1	**2**
Betula	33	0	0	3	2	**38**
Alnus	68	1	0	0	6	**75**
Quercus	2	1	0	2	0	**5**
Ulmus	1	0	0	0	0	**1**
Salix	1	0	0	0	0	**1**
Coryloid	92	3	0	7	2	**104**
Ericaceae	25	2	0	0	1	**28**
Gramineae	17	11	0	18	2	**48**
Cyperaceae	0	0	0	3	0	**3**
Ranunculus type	3	0	0	0	0	**3**
Saxifraga	1	0	0	0	0	**1**
Rumex acetosa / sella	9	0	0	0	0	**9**
Urtica type	1	0	0	0	0	**1**
Plantago lanceolata	6	0	0	0	0	**6**
Compositae	1	0	0	0	0	**1**
Polypodium vulgare	1	0	0	0	0	**1**
Pteridium	1	0	0	0	0	**1**
Filicales undiff.	8	0	0	0	0	**8**
Total	**271**	**18**	**0**	**33**	**14**	**336**
Indeterminate	C4	0	1	3	5	**13**
Sphagnum						**96**
Lycopodium clavatum						**185**
Tilletia sphagni						**1**
Carbon frags.						**91**

Table 14 Methvern 176cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	0	1	**2**
Betula	29	2	0	1	8	**40**
Alnus	78	1	0	3	3	**85**
Quercus	3	1	0	1	0	**5**
Tilia	1	0	0	0	0	**1**
Salix	1	0	0	0	0	**1**
Coryloid	87	3	0	5	3	**98**
Ericaceae	21	0	0	2	0	**23**
Gramineae	8	4	0	2	3	**17**
Cyperaceae	1	6	0	6	1	**14**
Ranunculus type	2	0	0	0	0	**2**
Filipendula	3	0	0	0	0	**3**
Rumex acetosa / sella	4	1	0	0	0	**5**
Urtica type	1	0	0	0	0	**1**
Plantago lanceolata	1	0	0	0	0	**1**
Compositae lig.	3	0	0	0	0	**3**
Polypodium vulgare	3	0	0	0	0	**3**
Pteridium	4	0	0	2	0	**6**
Filicales undiff.	6	0	0	0	0	**6**
Total	**257**	**18**	**0**	**22**	**19**	**316**
Indeterminate	C4	1	0	5	9	**19**
Sphagnum						**115**
Lycopodium clavatum						**117**
Tilletia sphagni						**1**
Carbon frags.						**18**

Table 15 Methvern 180cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	6	0	0	1	2	9
Betula	39	0	1	1	3	**44**
Alnus	94	1	0	1	2	**98**
Quercus	4	0	0	2	0	**6**
Ulmus	0	0	0	1	0	**1**
Salix	1	0	0	0	0	**1**
Ericaceae	15	1	0	0	0	**16**
Gramineae	53	5	1	11	8	**78**
Cyperaceae	3	0	0	6	0	**9**
Ranunculus type	6	0	0	0	0	**6**
Caryophyllaceae	1	0	0	0	0	**1**
Filipendula	2	0	0	0	0	**2**
Rumex acetosa / sella	7	0	0	0	0	**7**
Trientalis europaea	1	0	0	0	0	**1**
Plantago lanceolata	6	0	0	0	0	**6**
Polypodium vulgare	1	0	0	0	0	**1**
Pteridium	13	0	0	0	0	**13**
Filicales undiff.	9	0	0	0	3	**12**
Total	**261**	**7**	**2**	**23**	**18**	**311**
Indeterminate	C1	1	0	9	6	**17**
Sphagnum						**204**
Lycopodium clavatum						**138**
Tilletia sphagni						**1**
Carbon frags.						**21**

Table 16 Methvern 184cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	3	1	0	1	0	5
Betula	27	3	0	0	1	**31**
Alnus	62	3	0	1	2	**68**
Quercus	6	0	0	2	1	**9**
Ulmus	2	0	1	1	0	**4**
Coryloid	83	2	0	4	0	**89**
Ericaceae	18	2	0	0	2	**22**
Gramineae	26	23	0	12	0	**61**
Cyperaceae	0	0	0	12	0	**12**
Ranunculus type	3	0	0	1	0	**4**
Filipendula	1	0	0	0	0	**1**
Rumex acetosa / sella	4	0	0	0	1	**5**
Plantago lanceolata	1	0	0	0	1	**2**
Polypodium vulgare	3	0	0	0	0	**3**
Pteridium	4	0	0	0	0	**4**
Filicales undiff.	9	0	0	0	0	**9**
Total	**252**	**34**	**1**	**34**	**8**	**329**
Indeterminate	C1	0	0	4	2	7
Sphagnum						212
Lycopodium clavatum						**1**
Carbon frags.						51

Table 17 Methvern 188cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Betula	19	0	1	0	4	**24**
Alnus	66	0	1	1	5	**73**
Quercus	3	0	0	0	0	**3**
Ulmus	3	0	0	0	0	**3**
Coryloid	64	3	0	2	2	**71**
Ericaceae	18	2	0	1	1	**22**
Gramineae	52	4	0	5	2	**52**
Cyperaceae	1	0	0	3	0	**4**
Ranunculus type	2	0	0	0	0	**2**
Caryophyllaceae	2	0	0	0	0	**2**
Rosaceae undiff.	2	0	0	0	0	**2**
Filipendula	6	0	0	0	0	**6**
Potentilla erecta	1	0	0	0	0	**1**
Umbelliferae	3	0	0	0	0	**3**
Rumex acetosa / sella	8	0	0	1	0	**9**
Urtica type	1	0	0	1	0	**2**
Lysimachia vulgaris	2	0	0	0	0	**2**
Plantago lanceolata	20	0	0	0	0	**20**
Plantago media/major	4	0	0	0	0	**4**
Pteridium	9	0	0	0	0	**9**
Filicales undiff.	8	0	0	1	1	**10**
Total	**294**	**9**	**2**	**15**	**15**	**324**
Indeterminate	C2	1	0	10	5	**18**
Sphagnum						**49**
Lycopodium clavatum						**55**
Tilletia sphagni						**1**
Carbon frags.						**69**

Table 18 Methvern 192cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	1	1	**3**
Betula	30	2	0	4	0	**36**
Alnus	59	0	0	1	4	**64**
Quercus	4	1	0	1	0	**6**
Salix	1	0	0	0	0	**1**
Coryloid	113	3	0	3	2	**121**
Ericaceae	26	3	0	4	0	**33**
Gramineae	6	8	0	11	2	**27**
Cyperaceae	2	2	0	2	0	**6**
Ranunculus type	2	0	0	0	1	**3**
Rumex acetosa / sella	8	0	0	1	0	**9**
Urtica type	2	0	0	0	0	**2**
Plantago lanceolata	4	0	0	0	0	**4**
Pteridium	3	0	0	0	0	**3**
Filicales undiff.	3	0	0	0	0	**3**
Total	**264**	**19**	**0**	**28**	**10**	**321**
Indeterminate	C2	3	0	2	4	**11**
Sphagnum						**21**
Lycopodium clavatum						**29**
Tilletia sphagni						**3**
Carbon frags.						55

Table 19 Methvern 196cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	0	1	**2**
Betula	27	3	0	2	3	**35**
Alnus	80	2	0	0	4	**86**
Quercus	6	0	0	1	2	**9**
Ulmus	1	0	0	1	0	**2**
Coryloid	101	0	0	4	0	**105**
Ericaceae	18	1	0	1	0	**20**
Gramineae	26	8	0	10	0	**44**
Ranunculus type	1	0	0	1	0	**2**
Rumex acetosa / sella	11	0	0	3	1	**15**
Plantago lanceolata	1	0	0	0	0	**1**
Plantago media / major	1	0	0	0	0	**1**
Pteridium	2	0	0	0	0	**2**
Filicales undiff.	4	0	0	1	0	**5**
Total	**280**	**14**	**0**	**24**	**11**	**329**
Indeterminate	C1	0	0	7	3	**11**
Sphagnum						**31**
Lycopodium clavatum						**59**
Tilletia sphagni						**5**
Carbon frags.						**80**

Table 20 Methvern 200cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	0	1	**2**
Betula	44	0	0	1	2	**47**
Alnus	82	2	0	1	1	**86**
Quercus	4	0	0	1	0	**5**
Ulmus	1	0	1	0	1	**3**
Salix	1	0	0	0	0	**1**
Coryloid	110	1	0	0	3	**114**
Ericaceae	24	0	0	1	1	**26**
Gramineae	4	7	0	3	0	**14**
Cereal type	1	0	0	0	0	**1**
Cyperaceae	1	0	0	3	0	**4**
Ranunculus type	4	0	0	0	0	**4**
Rosaceae undiff.	2	0	0	0	0	**2**
Filipendula	1	0	0	0	0	**1**
Drosera rotundifolia	1	0	0	0	0	**1**
Rumex acetosa / sella	13	0	0	0	0	**13**
Urtica type	2	0	0	0	0	**2**
Plantago lanceolata	1	0	0	0	0	**1**
Pteridium	4	0	0	0	0	**4**
Filicales undiff.	5	0	0	0	0	**5**
Total	**306**	**10**	**1**	**10**	**9**	**336**
Sphagnum	68	0	0	0	0	**68**
Hippuris vulgaris	1	0	0	0	0	**1**
Indeterminate	C1	1	0	6	1	**9**
Lycopodium clavatum						**73**
Tilletia sphagni						**2**
Carbon frags.						52

Table 21 Methvern 204 cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	0	0	0	1	1	**2**
Betula	29	2	0	1	3	**35**
Alnus	81	3	0	1	0	**85**
Quercus	7	0	0	0	0	**7**
Ulmus	1	0	0	0	0	**1**
Salix	0	0	0	1	0	**1**
Coryloid	114	9	2	2	0	**127**
Ericaceae	23	0	0	0	0	**23**
Gramineae	2	2	0	8	0	**12**
Cyperaceae	0	0	0	4	0	**4**
Ranunculus type	3	0	0	0	0	**3**
Papaver undiff.	1	0	0	0	0	**1**
Rosaceae undiff.	2	0	0	0	0	**2**
Filipendula	1	0	0	0	0	**1**
Drosera rotundifolia	2	0	0	0	0	**2**
Rumex acetosa / sella	8	0	0	2	0	**10**
Urtica type	1	0	0	0	0	**1**
Plantago lanceolata	6	0	0	0	0	**6**
Plantago media / major	1	0	0	0	0	**1**
Polypodium undiff.	1	0	0	0	0	**1**
Pteridium	6	0	0	0	0	**6**
Filicales undiff.	1	1	0	0	1	**3**
Total	**290**	**17**	**2**	**20**	**5**	**334**
Indeterminate	C3	0	0	6	3	**12**
Sphagnum						**53**
Lycopodium clavatum						**55**
Carbon frags.						**41**

Table 22 Methvern 208cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	1	1	**3**
Betula	19	0	0	4	0	**23**
Alnus	72	2	1	0	10	**85**
Quercus	8	1	0	0	0	**9**
Coryloid	128	5	0	4	3	**140**
Ericaceae	17	2	0	2	0	**21**
Gramineae	5	2	0	2	1	**10**
Cyperaceae	0	1	0	2	0	**3**
Ranunculus type	1	0	0	0	0	**1**
Rosaceae undiff.	1	0	0	0	0	**1**
Rumex acetosa / sella	6	0	0	0	1	**7**
Urtica type	3	0	0	1	0	**4**
Plantago lanceolata	3	1	0	0	0	**4**
Polypodium undiff.	1	0	0	0	0	**1**
Pteridium	2	0	0	1	0	**3**
Filicales undiff.	1	0	0	0	0	**1**
Total	**268**	**14**	**1**	**17**	**16**	**316**
Indeterminate	C3	0	0	8	3	**14**
Sphagnum						**32**
Lycopodium clavatum						**30**
Carbon frags.						**23**

Table 23 Methvern 212cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	3	0	0	1	0	**4**
Betula	37	2	0	5	2	**46**
Alnus	109	7	0	0	0	**116**
Quercus	3	1	0	2	0	**6**
Coryloid	139	4	0	4	1	**148**
Ericaceae	11	0	0	0	0	**11**
Gramineae	3	5	0	0	0	**8**
Cyperaceae	1	1	0	3	0	**5**
Rumex acetosa / sella	4	0	0	0	0	**4**
Plantago lanceolata	1	1	0	0	0	**2**
Plantago media / major	1	0	0	0	0	**1**
Pteridium	7	0	0	0	0	**7**
Filicales undiff.	7	1	0	0	2	**10**
Total	**326**	**22**	**0**	**15**	**5**	**368**
Indeterminate	0	4	0	7	2	**13**
Sphagnum						**43**
Lycopodium clavatum						**61**
Carbon frags.						**38**

Table 24 Methvern 216cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	2	1	0	0	0	**3**
Betula	29	2	0	2	1	**34**
Alnus	40	10	0	0	2	**52**
Quercus	8	2	0	1	0	**11**
Ulmus	2	0	0	2	0	**4**
Coryloid	136	7	0	6	1	**150**
Ericaceae	16	3	0	0	0	**19**
Gramineae	2	14	0	2	1	**19**
Cyperaceae	0	12	0	4	0	**16**
Rumex acetosa / sella	5	1	0	1	1	**8**
Urtica type	2	0	0	0	0	**2**
Trientalis europaea	1	0	0	0	0	**1**
Plantago lanceolata	1	0	0	0	0	**1**
Compositae lig.	1	0	0	0	0	**1**
Polypodium undiff.	1	0	0	0	0	**1**
Pteridium	1	0	0	1	0	**2**
Filicales undiff.	5	0	0	0	0	**5**
Total	**252**	**52**	**0**	**19**	**6**	**329**
Indeterminate	C2	7	0	6	3	**18**
Sphagnum						**90**
Lycopodium clavatum						**50**
Carbon frags.						**13**

Table 25 Methvern 220cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	0	0	**1**
Betula	17	2	0	4	1	**24**
Alnus	54	7	0	1	2	**64**
Quercus	5	0	0	0	0	**5**
Ulmus	2	0	0	0	0	**2**
Salix	1	0	0	0	0	**1**
Coryloid	135	11	0	2	2	**150**
Ericaceae	14	0	0	3	0	**17**
Gramineae	6	10	0	1	1	**18**
Cyperaceae	0	2	0	5	0	**7**
Ranunculus type	2	0	0	0	0	**2**
Papaver undiff.	1	0	0	0	0	**1**
Rosaceae undiff.	2	0	0	0	0	**2**
Filipendula	1	0	0	0	0	**1**
Rumex acetosa / sella	11	0	0	1	0	**12**
Urtica type	1	0	0	0	0	**1**
Humulus / Cannabis	1	0	0	0	0	**1**
Compositae lig.	3	0	0	0	0	**3**
Pteridium	4	0	0	0	0	**4**
Filicales undiff.	6	0	0	0	0	**6**
Total	**267**	**32**	**0**	**17**	**6**	**322**
Indeterminate	C3	7	0	2	1	**13**
Sphagnum						**120**
Lycopodium clavatum						**26**
Carbon frags.						**12**

Table 26 Methvern 224cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	2	0	0	0	2	**4**
Betula	44	1	0	0	1	**46**
Alnus	67	3	0	0	1	**71**
Quercus	7	2	0	0	0	**9**
Ulmus	4	0	0	1	0	**5**
Coryloid	127	4	0	4	1	**136**
Ericaceae	19	0	0	3	0	**22**
Gramineae	6	5	0	2	0	**13**
Cyperaceae	0	3	0	3	0	**6**
Ranunculus type	3	0	0	0	0	**3**
Rumex acetosa / sella	11	0	0	0	0	**11**
Plantago lanceolata	1	0	0	0	0	**1**
Pteridium	2	0	0	1	0	**3**
Filicales undiff.	6	0	0	0	1	**7**
Total	**299**	**18**	**0**	**14**	**6**	**337**
Indeterminate	C4	3	0	3	5	**15**
Sphagnum						**38**
Lycopodium clavatum						**39**
Tilletia sphagni						**4**
Carbon frags.						**2**

Table 27 Methvern 228cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	1	0	0	1	**3**
Betula	50	10	0	1	3	**64**
Alnus	63	1	0	0	1	**65**
Quercus	9	0	0	1	0	**10**
Ulmus	5	0	0	0	0	**5**
Salix	1	0	0	0	0	**1**
Coryloid	103	8	0	1	0	**112**
Ericaceae	20	2	0	0	0	**22**
Gramineae	7	8	0	0	0	**15**
Cyperaceae	0	3	0	2	0	**5**
Ranunculus type	4	0	0	1	0	**5**
Caryophyllaceae	1	0	0	0	0	**1**
Rosaceae undiff.	3	0	0	0	0	**3**
Rumex acetosa / sella	9	2	0	0	0	**11**
Polypodium undiff.	1	0	0	0	0	**1**
Pteridium	1	0	0	0	0	**1**
Filicales undiff.	5	0	0	0	0	5
Total	**283**	**35**	**0**	**6**	**5**	**329**
Indeterminate	C4	5	0	4	4	**17**
Sphagnum						**52**
Lycopodium clavatum						**39**
Tilletia sphagni						**4**
Carbon frags.						**2**

Table 28 Methvern 232cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	0	0	**1**
Betula	39	3	0	0	2	**44**
Alnus	52	2	0	0	1	**55**
Quercus	9	1	0	2	0	**12**
Ulmus	2	1	0	0	0	**3**
Coryloid	117	3	0	1	3	**124**
Ericaceae	22	0	0	0	0	**22**
Gramineae	8	21	0	4	0	**33**
Cyperaceae	1	3	0	0	0	**4**
Ranunculus type	5	0	0	0	0	**5**
Caryophyllaceae	1	0	0	0	0	**1**
Rosaceae undiff.	2	0	0	0	0	**2**
Saxifraga	1	0	0	0	0	**1**
Rumex acetosa / sella	11	2	0	0	0	**13**
Polypodium undiff.	1	0	0	0	0	**1**
Filicales undiff.	4	0	0	0	1	**5**
Total	**276**	**36**	**0**	**7**	**7**	**326**
Indeterminate	C2	10	0	7	2	**21**
Sphagnum						**137**
Lycopodium clavatum						**34**
Tilletia sphagni						**12**
Carbon frags						**5**

Table 29 Methvern 236cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	1	0	0	1	**3**
Betula	20	2	0	2	0	**24**
Alnus	51	7	0	1	1	**60**
Quercus	4	0	0	3	0	**7**
Ulmus	2	1	0	2	0	**5**
Coryloid	140	6	1	8	7	**162**
Ericaceae	46	3	0	3	1	**53**
Gramineae	6	2	0	1	1	**10**
Cyperaceae	1	1	0	1	0	**3**
Ranunculus type	0	1	0	0	0	**1**
Saxifraga	1	0	0	0	0	**1**
Rumex acetosa / sella	3	0	0	1	0	**4**
Urtica type	3	0	0	0	0	**3**
Trientalis europaea	1	0	0	0	0	**1**
Plantago lanceolata	2	0	0	0	0	**2**
Polypodium vulgare	2	0	0	1	0	**3**
Pteridium	1	0	0	0	0	**1**
Filicales undiff.	7	0	0	0	0	**7**
Dryopteris undiff.	1	0	0	0	0	**1**
Total	**292**	**24**	**1**	**23**	**11**	**351**
Indeterminate	C2	6	0	12	2	**22**
Sphagnum						**29**
Lycopodium clavatum						**40**
Carbon frags.						**15**

Table 30 Methvern 240cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	1	0	0	0	**2**
Betula	20	3	0	0	0	**23**
Alnus	62	3	0	1	2	**68**
Quercus	3	0	0	0	0	**3**
Ulmus	7	0	0	4	0	**11**
Coryloid	119	7	0	8	7	**141**
Ericaceae	25	7	0	1	0	**33**
Gramineae	6	6	1	3	1	**17**
Cyperaceae	0	0	0	4	0	**4**
Ranunculus type	2	0	0	1	0	**3**
Filipendula	1	0	0	0	0	**1**
Rumex acetosa / sella	5	0	0	1	0	**6**
Urtica type	1	0	0	0	0	**1**
Compositae tub.	4	0	0	0	0	**4**
Filicales undiff.	6	0	0	0	0	**6**
Total	**262**	**27**	**1**	**23**	**10**	**323**
Indeterminate	C1	5	1	6	2	**15**
Sphagnum						**14**
Lycopodium clavatum						**26**
Tilletia sphagni						**1**
Carbon frags.						**19**

Table 31 Methvern 244cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	0	0	0	3	1	**4**
Betula	15	0	0	2	5	**22**
Alnus	102	3	1	3	3	**112**
Quercus	6	0	0	0	1	**7**
Ulmus	5	0	0	4	0	**9**
Tilia	1	0	0	0	0	**1**
Coryloid	93	4	0	9	4	**110**
Ericaceae	37	5	0	3	0	**45**
Gramineae	0	2	0	2	0	**4**
Cyperaceae	0	0	0	4	0	**4**
Ranunculus type	2	0	0	0	0	**2**
Umbelliferae	1	0	0	0	0	**1**
Rumex acetosa / sella	1	0	0	0	0	**1**
Urtica type	2	0	0	0	0	**2**
Compositae tub.	1	0	0	0	0	**1**
Polypodium undiff.	5	0	0	0	0	**5**
Filicales undiff.	6	1	0	0	1	**8**
Total	**277**	**15**	**1**	**30**	**15**	**338**
Indeterminate	C1	3	0	10	8	**22**
Sphagnum						**8**
Lycopodium clavatum						**29**
Carbon frags.						**2**

Table 32 Methvern 248cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	0	1	0	1	1	**3**
Betula	12	0	0	1	0	**13**
Alnus	89	5	0	1	2	**97**
Quercus	3	0	0	2	0	**5**
Ulmus	2	0	0	0	1	**3**
Coryloid	128	5	0	6	2	**141**
Ericaceae	23	5	0	1	0	**29**
Gramineae	5	1	0	0	1	**7**
Cyperaceae	0	0	0	2	0	**2**
Ranunculus type	5	0	0	0	0	**5**
Rosaceae undiff.	1	0	0	0	0	**1**
Rumex acetosa / sella	9	2	0	1	0	**12**
Urtica type	0	1	0	0	0	**1**
Trientalis europaea	1	0	0	0	0	**1**
Plantago lanceolata	1	0	0	0	0	**1**
Compositae lig.	1	0	0	0	0	**1**
Polypodium undiff.	2	0	0	0	0	**2**
Pteridium	2	0	0	0	0	**2**
Filicales undiff.	7	0	0	0	0	**7**
Total	**291**	**20**	**0**	**15**	**7**	**333**
Indeterminate	0	1	2	4	1	**8**
Sphagnum						**78**
Lycopodium clavatum						**48**
Tilletia sphagni						**1**
Carbon frags.						**2**

Table 33 Methvern 252cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	4	0	0	0	1	5
Betula	14	1	0	0	1	**16**
Alnus	81	4	0	5	3	**93**
Quercus	9	2	0	2	1	**14**
Ulmus	4	0	0	1	1	**6**
Coryloid	118	6	0	9	4	**137**
Ericaceae	10	3	0	1	0	**14**
Gramineae	0	1	0	3	0	**4**
Cyperaceae	0	0	0	3	0	**3**
Ranunculus type	4	0	0	0	0	**4**
Caryophyllaceae	1	0	0	0	0	**1**
Rumex acetosa / sella	7	0	0	1	0	**8**
Urtica type	1	0	0	3	0	**4**
Plantago lanceolata	1	0	0	0	0	**1**
Aster type	24	0	0	0	0	**24**
Pteridium	2	0	0	0	0	**2**
Filicales undiff.	7	0	0	0	0	**7**
Total	**287**	**17**	**0**	**28**	**11**	**343**
Indeterminate	C1	4	0	8	2	**15**
Sphagnum						**109**
Lycopodium clavatum						**48**
Carbon frags.						**6**

Table 34 Methvern 256cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	2	0	0	0	1	**3**
Betula	22	0	0	1	0	**23**
Alnus	82	3	0	1	5	**91**
Quercus	5	0	0	1	0	**6**
Ulmus	14	0	0	1	0	**15**
Coryloid	138	7	0	1	3	**149**
Ericaceae	19	1	0	0	0	**20**
Gramineae	5	2	0	4	1	**12**
Cyperaceae	0	1	0	1	0	**2**
Ranunculus type	1	0	0	0	0	**1**
Saxifraga	1	0	0	0	0	**1**
Rumex acetosa / sella	11	1	0	0	0	**12**
Gentianella campestris	1	0	0	0	0	**1**
Plantago media / major	2	0	0	0	0	**2**
Pteridium	1	0	0	0	1	**2**
Filicales undiff.	3	0	0	0	0	**3**
Total	**307**	**15**	**0**	**10**	**11**	**343**
Indeterminate	C1	4	1	2	1	**8**
Sphagnum						**30**
Lycopodium clavatum						**33**
Carbon frags.						**57**

Table 35 Methvern 260cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	0	0	0	0	1	**1**
Betula	15	0	0	1	0	**16**
Alnus	90	4	0	2	4	**100**
Quercus	6	2	0	0	0	**8**
Ulmus	7	0	0	2	0	**9**
Salix	1	0	0	0	0	**1**
Coryloid	121	5	0	8	4	**138**
Ericaceae	35	3	0	1	0	**39**
Gramineae	1	0	1	2	0	**4**
Cyperaceae	1	1	0	0	0	**2**
Ranunculus type	2	0	0	0	0	**2**
Caryophyllaceae	1	0	0	0	0	**1**
Rumex acetosa / sella	7	0	0	0	0	**7**
Urtica type	1	0	0	0	0	**1**
Compositae tub.	2	0	0	0	0	**2**
Polypodium undiff.	3	0	0	0	0	**3**
Pteridium	3	0	1	0	0	**4**
Filicales undiff.	7	1	0	0	1	**9**
Total	**303**	**16**	**2**	**16**	**10**	**347**
Indeterminate	C3	5	0	11	4	**23**
Sphagnum						**44**
Lycopodium clavatum						**40**
Carbon frags.						54

Table 36 Methvern 264cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	1	0	**2**
Betula	19	5	0	1	0	**25**
Alnus	86	14	0	7	3	**110**
Quercus	4	3	0	1	1	**9**
Ulmus	3	0	0	3	0	**6**
Salix	1	0	0	0	0	**1**
Coryloid	117	9	0	13	4	**143**
Ericaceae	22	4	0	3	0	**29**
Gramineae	1	0	0	1	0	**2**
Rumex acetosa / sella	1	0	0	0	0	**1**
Urtica type	3	0	0	0	0	**3**
Pteridium	1	0	0	0	0	**1**
Filicales undiff.	5	1	0	0	1	**7**
Blechnum spicant	1	0	0	0	0	**1**
Total	**265**	**36**	**0**	**30**	**9**	**340**
Indeterminate	C1	6	0	11	2	**20**
Sphagnum						**1**
Lycopodium clavatum						**22**
Carbon frags.						**8**

Table 37 Methvern 268cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	0	1	**2**
Betula	29	1	1	2	4	**37**
Alnus	87	4	1	4	3	**99**
Quercus	9	1	0	2	0	**12**
Ulmus	5	0	0	1	0	**6**
Tilia	1	0	0	0	0	**1**
Salix	1	0	0	0	0	**1**
Coryloid	103	6	0	6	4	**119**
Ericaceae	22	2	0	2	0	**26**
Gramineae	5	2	0	6	0	**13**
Cyperaceae	0	1	0	0	0	**1**
Rumex acetosa / sella	2	0	0	1	0	**3**
Urtica type	0	1	0	0	0	**1**
Trientalis europaea	1	0	0	0	0	**1**
Polypodium vulgare	4	0	0	0	0	**4**
Total	**270**	**18**	**2**	**24**	**12**	**326**
Indeterminate	C1	5	0	8	1	**15**
Sphagnum						**6**
Lycopodium clavatum						**28**
Tilletia sphagni						**1**
Carbon frags.						**20**

Table 38 Methvern 272cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	0	1	**2**
Betula	9	0	0	1	1	**11**
Alnus	88	5	0	0	3	**96**
Quercus	8	0	0	0	0	**8**
Ulmus	5	0	0	1	0	**5**
Salix	1	0	0	0	0	**1**
Coryloid	151	4	0	2	4	**161**
Ericaceae	17	2	0	1	0	**20**
Gramineae	5	5	0	2	1	**13**
Cyperaceae	0	1	0	2	0	**3**
Filipendula	1	0	0	0	0	**1**
Rumex acetosa / sella	6	0	0	0	0	**6**
Urtica type	2	0	0	0	0	**2**
Rhinanthus type	1	0	0	0	0	**1**
Compositae lig.	3	0	0	0	0	**3**
Polypodium vulgare	2	0	0	0	0	**2**
Pteridium	1	0	0	0	0	**1**
Filicales undiff.	2	0	0	0	1	**3**
Total	**303**	**17**	**0**	**9**	**11**	**339**
Indeterminate	C1	2	1	3	3	**10**
Sphagnum						**16**
Lycopodium clavatum						**10**
Tilletia sphagni						**1**
Carbon frags.						**12**

Table 39 Methvern 276cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	0	0	0	0	1	**1**
Betula	29	0	0	0	3	**32**
Alnus	94	0	0	0	5	**99**
Quercus	7	1	0	1	0	**9**
Ulmus	7	1	0	0	1	**9**
Coryloid	87	3	0	1	1	**92**
Ericaceae	28	3	0	2	0	**33**
Gramineae	12	2	0	4	2	**20**
Cyperaceae	2	2	0	2	0	**6**
Ranunculus type	3	1	0	0	0	**4**
Rosaceae undiff.	1	0	0	0	0	**1**
Rumex acetosa / sella	6	0	0	1	1	**8**
Plantago lanceolata	1	0	0	0	0	**1**
Compositae lig.	1	0	0	0	0	**1**
Polypodium vulgare	3	0	0	0	0	**3**
Pteridium	3	0	0	0	0	**3**
Filicales undiff.	6	0	0	0	0	**6**
Total	**290**	**13**	**0**	**11**	**14**	**328**
Indeterminate	C1	4	0	1	5	**11**
Sphagnum						**33**
Lycopodium clavatum						**41**
Tilletia sphagni						**8**
Carbon frags.						**17**

Table 40 Methvern 280cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	2	0	0	0	1	**3**
Betula	25	0	0	0	0	**25**
Alnus	74	3	0	1	1	**79**
Quercus	5	0	0	1	0	**6**
Ulmus	1	0	0	3	0	**4**
Coryloid	124	5	0	4	4	**137**
Ericaceae	43	6	0	2	0	**51**
Gramineae	2	0	0	11	0	**13**
Cyperaceae	1	5	0	5	0	**11**
Ranunculus type	1	0	0	1	0	**2**
Sinapis	1	0	0	0	0	**1**
Rosaceae undiff.	1	0	0	0	0	**1**
Rumex acetosa / sella	9	0	0	0	0	**9**
Urtica type	1	0	0	0	0	**1**
Trientalis europaea	1	0	0	0	0	**1**
Plantago lanceolata	1	0	0	0	0	**1**
Compositae lig.	3	0	0	0	0	**3**
Polypodium undiff.	1	0	0	0	0	**1**
Pteridium	2	0	0	0	0	**2**
Filicales undiff.	5	0	0	0	0	**5**
Total	**303**	**19**	**0**	**28**	**6**	**356**
Indeterminate	C4	2	0	3	5	**14**
Sphagnum						**87**
Lycopodium clavatum						**38**
Tilletia sphagni						**16**
Carbon frags.						**15**

Table 41 Methvern 284cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	2	0	0	0	1	**3**
Betula	16	2	0	0	1	**19**
Alnus	67	1	0	0	1	**69**
Quercus	11	2	0	4	1	**18**
Ulmus	5	0	0	1	1	**7**
Coryloid	130	6	0	3	2	**141**
Ericaceae	17	2	0	0	0	**19**
Gramineae	6	4	0	4	1	**15**
Cyperaceae	1	4	0	6	0	**11**
Ranunculus type	3	0	0	0	2	**5**
Rosaceae undiff.	1	0	0	0	0	**1**
Rumex acetosa / sella	10	0	0	0	0	**10**
Compositae lig.	2	0	0	0	1	**3**
Pteridium	3	0	0	0	0	**3**
Filicales undiff.	3	0	0	0	0	**3**
Total	**277**	**21**	**0**	**18**	**11**	**327**
Indeterminate	C1	2	0	2	4	**9**
Sphagnum						**97**
Lycopodium clavatum						**27**
Tilletia sphagni						**8**
Carbon frags.						**48**

Table 42 Methvern 288cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	8	0	0	2	1	**11**
Betula	27	3	0	0	0	**30**
Alnus	117	4	0	1	5	**127**
Quercus	8	3	0	1	0	**12**
Ulmus	3	1	0	2	0	**6**
Salix	1	0	0	0	0	**1**
Coryloid	184	8	0	9	6	**207**
Ericaceae	26	5	0	5	0	**36**
Gramineae	3	3	0	5	0	**11**
Cyperaceae	0	0	0	3	0	**3**
Caltha type	1	0	0	0	0	**1**
Ranunculus type	3	0	0	0	0	**3**
Rosaceae undiff.	1	0	0	0	0	**1**
Rumex acetosa / sella	7	0	0	0	1	**8**
Urtica type	0	0	0	1	0	**1**
Plantago lanceolata	0	0	0	0	1	**1**
Polypodium undiff.	2	0	0	0	0	**2**
Pteridium	1	0	0	0	0	**1**
Filicales undiff.	2	0	0	0	0	**2**
Total	**394**	**27**	**0**	**29**	**14**	**464**
Indeterminate	3	2	0	4	6	**15**
Sphagnum						**40**
Lycopodium clavatum						**56**
Tilletia sphagni						**11**
Carbon frags.						**25**

Table 43 Methvern 292cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	2	0	0	1	0	**3**
Betula	13	2	0	0	1	**16**
Alnus	104	1	0	2	0	**107**
Quercus	14	1	0	4	0	**19**
Ulmus	3	1	0	2	0	**6**
Coryloid	114	4	0	1	1	**120**
Ericaceae	7	1	0	1	0	**9**
Gramineae	6	5	0	7	0	**18**
Cyperaceae	0	3	0	3	0	**6**
Ranunculus type	1	0	0	0	0	**1**
Rosaceae undiff.	1	0	0	0	0	**1**
Umbelliferae	1	0	0	0	0	**1**
Rumex acetosa / sella	2	0	0	0	0	**2**
Plantago lanceolata	3	0	0	0	0	**3**
Polypodium vulgare	2	0	0	0	0	**2**
Pteridium	1	0	0	0	0	**1**
Filicales undiff.	3	0	0	0	0	**3**
Total	**277**	**18**	**0**	**21**	**2**	**318**
Indeterminate	C2	4	0	4	3	**13**
Sphagnum						**36**
Lycopodium clavatum						**13**
Tilletia sphagni						**1**
Carbon frags.						**12**

Table 44 Methvern 296cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	3	1	0	0	1	**5**
Betula	17	1	0	1	2	**21**
Alnus	100	4	0	1	7	**112**
Quercus	5	1	0	2	1	**9**
Ulmus	3	0	0	0	0	**3**
Coryloid	110	2	0	5	1	**118**
Ericaceae	15	0	0	0	0	**15**
Gramineae	6	3	0	2	1	**12**
Cyperaceae	0	4	0	3	0	**7**
Ranunculus type	1	0	0	0	0	**1**
Rumex acetosa / sella	2	0	0	3	0	**5**
Urtica type	3	0	0	0	0	**3**
Plantago lanceolata	1	0	0	0	1	**2**
Compositae tub.	1	0	0	0	0	**1**
Polypodium undiff.	2	0	0	0	0	**2**
Pteridium	1	0	0	1	0	**2**
Filicales undiff.	3	0	0	0	0	**3**
Total	**273**	**16**	**0**	**18**	**14**	**321**
Indeterminate	C6	4	1	8	5	**24**
Sphagnum						**33**
Lycopodium clavatum						**21**
Tilletia sphagni						**2**
Carbon frags.						**51**

Table 45 Methvern 300cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	0	1	**2**
Betula	30	0	0	2	0	**32**
Alnus	80	8	0	1	0	**89**
Quercus	11	0	0	1	0	**12**
Ulmus	6	0	0	0	0	**6**
Coryloid	103	6	0	3	3	**115**
Ericaceae	29	4	0	0	0	**33**
Gramineae	4	8	0	2	0	**14**
Cyperaceae	2	3	0	2	0	**7**
Ranunculus type	3	0	0	0	0	**3**
Rosaceae undiff.	2	0	0	0	0	**2**
Filipendula	1	0	0	0	0	**1**
Rumex acetosa / sella	4	0	0	0	1	**5**
Urtica type	1	0	0	0	0	**1**
Plantago lanceolata	2	0	0	1	0	**3**
Compositae lig.	2	0	0	0	0	**2**
Pteridium	4	0	0	0	0	**4**
Filicales undiff.	4	0	0	0	0	**4**
Total	**289**	**29**	**0**	**12**	**5**	**335**
Indeterminate	C2	4	0	4	0	**10**
Sphagnum						**86**
Lycopodium clavatum						**27**
Tilletia sphagni						**2**
Carbon frags.						**20**

Table 46 Methvern 304cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	1	0	**2**
Betula	15	0	0	0	2	**17**
Alnus	94	4	2	3	1	**104**
Quercus	3	0	0	0	0	**3**
Ulmus	6	0	0	0	0	**6**
Coryloid	132	5	0	7	3	**147**
Ericaceae	34	2	0	1	0	**37**
Gramineae	5	1	0	1	0	**7**
Ranunculus type	2	0	0	0	0	**2**
Filipendula	2	0	0	0	0	**2**
Rumex acetosa /sella	5	0	0	1	0	**6**
Rumex obusifolius	1	0	0	0	0	**1**
Urtica type	4	0	0	0	0	**4**
Plantago lanceolata	2	0	0	0	0	**2**
Plantago media / major	1	0	0	0	0	**1**
Pteridium	1	0	0	0	0	**1**
Filicales undiff.	3	0	0	1	0	**4**
Total	**311**	**12**	**2**	**15**	**6**	**346**
Indeterminate	C2	2	0	7	0	**11**
Sphagnum						**36**
Lycopodium clavatum						**24**
Tilletia sphagni						**2**
Carbon frags.						**44**

Table 47 Methvern 308cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Betula	20	0	0	1	0	**21**
Alnus	107	3	0	0	2	**112**
Quercus	13	1	0	3	1	**18**
Ulmus	1	0	0	0	0	**1**
Salix	1	0	0	0	0	**1**
Coryloid	114	7	0	4	0	**125**
Ericaceae	28	4	0	0	0	**32**
Gramineae	11	1	0	1	0	**13**
Cyperaceae	1	1	0	1	0	**3**
Rumex acetosa / sella	3	0	0	0	0	**3**
Urtica type	1	0	0	0	0	**1**
Plantago lanceolata	2	0	0	0	0	**2**
Compositae lig.	1	0	0	0	0	**1**
Polypodium vulgare	1	0	0	0	0	**1**
Pteridium	1	0	0	0	0	**1**
Filicales undiff.	2	0	0	0	0	**2**
Total	**307**	**17**	**0**	**10**	**3**	**337**
Indeterminate	C1	3	0	3	2	**9**
Sphagnum						**32**
Lycopodium clavatum						**30**
Carbon frags.						**41**

Table 48 Methvern 310cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	0	0	**1**
Betula	28	1	0	0	0	**29**
Alnus	84	3	0	3	3	**93**
Quercus	8	2	0	3	0	**13**
Ulmus	2	0	0	0	0	**2**
Salix	1	0	0	0	0	**1**
Coryloid	100	5	0	9	2	**116**
Ericaceae	25	7	0	0	0	**32**
Gramineae	3	5	0	4	0	**12**
Cyperaceae	1	3	0	16	1	**21**
Filipendula	1	0	0	0	0	**1**
Rumex acetosa / sella	4	0	0	1	1	**6**
Urtica type	1	0	0	0	0	**1**
Trientalis europaea	1	0	0	0	0	**1**
Plantago lanceolata	2	0	0	0	0	**2**
Compositae lig.	3	0	0	0	0	**3**
Pteridium	1	1	0	0	0	**2**
Polypodium vulgare	1	0	0	0	0	**1**
Total	**267**	**27**	**0**	**36**	**7**	**337**
Indeterminate	C1	1	1	12	0	**15**
Sphagnum						**20**
Lycopodium clavatum						**2**
Tilletia sphagni						**5**
Carbon frags.						**76**

Table 49 Methvern 312cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	2	0	**3**
Betula	33	3	0	1	4	**41**
Alnus	78	2	0	0	0	**80**
Quercus	5	1	0	1	0	**7**
Ulmus	1	0	0	0	0	**1**
Coryloid	151	0	0	0	0	**151**
Ericaceae	17	1	0	0	0	**18**
Gramineae	0	5	0	1	0	**6**
Cyperaceae	0	0	0	4	0	**4**
Ranunculus type	0	0	0	0	1	**1**
Rumex acetosa / sella	4	0	0	0	0	**4**
Plantago media/major	1	0	0	0	0	**1**
Pteridium	2	0	0	0	0	**2**
Filicales undiff.	9	0	0	0	0	**9**
Total	**302**	**12**	**0**	**9**	**5**	**328**
Indeterminate	0	7	0	6	0	**13**
Sphagnum						**39**
Lycopodium clavatum						**42**
Carbon frags.						**38**

Table 50 Methvern 314cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	3	0	0	0	0	**3**
Betula	16	3	0	3	0	**22**
Alnus	79	4	0	2	1	**86**
Quercus	3	2	0	5	0	**10**
Ulmus	2	1	0	0	0	**3**
Coryloid	126	9	0	8	2	**145**
Ericaceae	43	4	0	2	0	**49**
Gramineae	4	3	0	4	0	**11**
Cyperaceae	0	0	0	66	0	**6**
Filipendula	1	0	0	0	0	**1**
Rumex acetosa / sella	6	0	0	1	0	**7**
Urtica type	2	0	0	1	0	**3**
Plantago lanceolata	2	0	0	0	0	**2**
Succisa	1	0	0	0	0	**1**
Filicales undiff.	3	0	0	0	0	**3**
Total	**291**	**26**	**0**	**92**	**3**	**352**
Indeterminate	C1	6	0	4	0	**11**
Sphagnum						**14**
Lycopodium clavatum						**42**
Tilletia sphagni						**4**
Carbon frags.						**90**

Table 51 Methvern 316cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	0	0	0	1	0	**1**
Betula	10	2	0	1	1	**14**
Alnus	73	5	0	0	3	**81**
Quercus	2	1	0	2	1	**6**
Ulmus	1	0	0	0	0	**1**
Tilia	1	0	0	0	0	**1**
Coryloid	117	8	0	8	3	**136**
Ericaceae	21	2	0	1	0	**24**
Gramineae	6	12	0	4	0	**22**
Cyperaceae	0	3	0	8	0	**11**
Ranunculus type	4	0	0	0	0	**4**
Rumex acetosa / sella	7	0	0	1	0	**8**
Trientalis europaea	1	0	0	0	0	**1**
Plantago lanceolata	2	1	0	0	1	**4**
Compositae lig.	1	0	0	0	0	**1**
Pteridium	2	0	0	0	0	**2**
Filicales undiff.	6	0	0	0	0	**6**
Total	**254**	**34**	**0**	**26**	**9**	**323**
Indeterminate	C2	7	0	6	2	**17**
Sphagnum						**28**
Lycopodium clavatum						**42**
Tilletia sphagni						**1**
Carbon frags.						**37**

Table 52 Methvern 318cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	0	0	0	0	1	**1**
Betula	16	3	0	1	0	**20**
Alnus	76	1	0	2	6	**85**
Quercus	19	1	1	1	0	**22**
Ulmus	2	0	0	0	0	**2**
Tilia	1	0	0	0	0	**1**
Coryloid	123	6	0	1	0	**130**
Ericaceae	22	0	0	3	0	**25**
Gramineae	6	5	0	2	0	**13**
Cyperaceae	0	2	0	4	0	**6**
Ranunculus type	1	0	0	0	0	**1**
Rosaceae undiff.	2	0	0	0	0	**2**
Rumex acetosa / sella	11	0	0	1	0	**12**
Urtica type	4	0	0	0	0	**4**
Polypodium vulgare	1	0	0	0	0	**1**
Filicales undiff.	4	0	0	1	0	**5**
Total	**288**	**18**	**1**	**16**	**7**	**330**
Indeterminate	C2	3	2	7	2	**16**
Sphagnum						**21**
Lycopodium clavatum						**25**
Carbon frags.						**76**

Table 53 Methvern 320cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	3	0	0	0	0	**3**
Betula	23	0	0	1	1	**25**
Alnus	74	1	0	2	3	**80**
Quercus	20	2	0	1	1	**24**
Ulmus	2	0	0	0	0	**2**
Coryloid	130	1	0	3	1	**135**
Ericaceae	38	0	0	1	0	**39**
Gramineae	7	1	0	0	0	**8**
Cyperaceae	2	0	0	4	0	**6**
Ranunculus type	2	0	0	0	0	**2**
Rosaceae undiff.	0	1	0	0	0	**1**
Filipendula	1	0	0	0	0	**1**
Rumex acetosa / sella	6	0	0	2	0	**8**
Urtica type	2	0	0	0	0	**2**
Polypodium undiff.	1	0	0	0	0	**1**
Filicales undiff.	3	0	0	1	0	**4**
Total	**314**	**6**	**0**	**15**	**6**	**341**
Indeterminate	C3	2	2	8	1	**16**
Sphagnum						**3**
Lycopodium clavatum						**13**
Carbon frags.						**43**

Table 54 Methvern 322cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	2	0	2	0	**5**
Betula	24	3	0	3	2	**32**
Alnus	64	3	0	0	0	**67**
Quercus	11	0	0	0	0	**11**
Ulmus	6	1	0	1	0	**8**
Salix	1	0	0	0	0	**1**
Coryloid	126	2	0	6	0	**134**
Ericaceae	24	1	0	2	0	**27**
Gramineae	2	2	0	2	0	**6**
Cyperaceae	0	3	0	2	0	**5**
Ranunculus type	5	0	0	0	0	**5**
Rosaceae undiff.	2	0	0	0	0	**2**
Filipendula	1	0	0	0	0	**1**
Rumex acetosa / sella	9	1	0	0	0	**10**
Urtica type	1	0	0	0	0	**1**
Pteridium	1	0	0	0	0	**1**
Polypodium undiff.	2	0	0	0	0	**2**
Total	**280**	**18**	**0**	**18**	**2**	**318**
Indeterminate	C2	9	0	7	1	**19**
Sphagnum						**2**
Lycopodium clavatum						**20**
Tilletia sphagni						**1**
Carbon frags.						**36**

Table 55 Methvern 324cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	1	0	**2**
Betula	23	1	0	0	0	**24**
Alnus	80	4	0	0	1	**85**
Quercus	12	0	0	1	1	**14**
Ulmus	14	3	0	5	0	**22**
Salix	1	0	0	0	0	**1**
Coryloid	120	6	0	3	1	**130**
Ericaceae	32	1	0	1	0	**34**
Gramineae	0	1	1	2	1	**5**
Cyperaceae	0	0	0	2	0	**2**
Ranunculus type	1	0	0	0	0	**1**
Rosaceae undiff.	1	0	0	0	0	**1**
Umbelliferae	1	0	0	0	0	**1**
Rumex acetosa / sella	8	0	0	0	2	**10**
Urtica type	1	0	0	0	0	**1**
Rhianthus type	1	0	0	0	0	**1**
Polypodium undiff.	3	0	0	0	0	**3**
Pteridium	1	0	0	1	0	**2**
Filicales undiff.	5	0	0	0	0	**5**
Total	**305**	**16**	**1**	**16**	**6**	**344**
Indeterminate	C4	1	0	7	4	**16**
Sphagnum						**14**
Lycopodium clavatum						**27**
Carbon frags.						**31**

Table 56 Methvern 326cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Betula	24	0	0	1	1	**26**
Alnus	84	1	0	1	2	**88**
Quercus	11	0	0	2	0	**13**
Ulmus	23	1	0	4	0	**28**
Salix	1	0	0	0	0	**1**
Coryloid	117	1	0	4	3	**125**
Ericaceae	25	5	0	1	0	**31**
Ranunculus type	1	0	0	1	0	**2**
Filipendula	1	0	0	0	0	**1**
Rumex acetosa / sella	3	0	0	2	0	**5**
Urtica type	1	0	0	0	0	**1**
Polypodium undiff.	1	0	0	0	0	**1**
Filicales undiff.	6	0	0	1	0	**7**
Total	**298**	**8**	**0**	**17**	**6**	**329**
Indeterminate	C1	3	0	11	0	**15**
Sphagnum						**6**
Lycopodium clavatum						**25**
Tilletia sphagni						**1**
Carbon frags.						**53**

Table 57 Methvern 328cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	2	0	0	0	2	**4**
Betula	19	1	0	1	1	**22**
Alnus	48	4	0	0	1	**53**
Quercus	11	3	0	4	0	**18**
Ulmus	22	1	0	3	1	**27**
Tilia	1	0	0	0	0	**1**
Salix	1	0	0	0	0	**1**
Coryloid	129	2	0	1	0	**132**
Ericaceae	28	4	0	3	1	**36**
Gramineae	2	0	0	2	1	**5**
Cyperaceae	0	2	0	6	0	**8**
Ranunculus type	2	0	0	0	0	**2**
Umbelliferae	1	0	0	0	0	**1**
Rumex acetosa / sella	6	0	0	0	0	**6**
Urtica type	2	0	0	0	0	**2**
Polypodium undiff.	4	0	0	0	0	**4**
Filicales undiff.	6	0	0	0	1	**7**
Total	**284**	**17**	**0**	**20**	**8**	**329**
Indeterminate	C1	1	1	9	2	**14**
Sphagnum						**16**
Lycopodium clavatum						**22**
Carbon frags.						**46**

Table 58 Methvern 330cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	4	0	0	0	0	**4**
Betula	27	0	0	3	2	**32**
Quercus	97	1	1	0	4	**103**
Ulmus	15	0	0	2	0	**17**
Coryloid	86	7	0	4	1	**98**
Ericaceae	32	3	0	1	1	**37**
Gramineae	1	1	0	0	0	**2**
Cyperaceae	0	3	0	9	0	**12**
Ranunculus type	2	0	0	2	0	**4**
Chenopodiaceae	1	0	0	0	0	**1**
Filipendula	1	0	0	0	0	**1**
Rumex acetosa / sella	3	0	0	1	0	**4**
Urtica type	1	0	0	0	0	**1**
Polypodium undiff.	2	0	0	0	0	**2**
Filicales undiff.	4	0	0	0	0	**4**
Total	**276**	**15**	**1**	**22**	**8**	**322**
Indeterminate	C2	6	0	9	2	**19**
Sphagnum						**14**
Lycopodium clavatum						**78**
Carbon frags.						**35**

Table 59 Methvern 332cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	2	0	0	1	0	**3**
Betula	16	0	0	0	1	**17**
Alnus	89	6	0	2	2	**99**
Quercus	5	0	0	0	1	**6**
Ulmus	16	0	0	5	0	**21**
Coryloid	103	2	0	7	0	**112**
Ericaceae	49	8	0	1	0	**58**
Gramineae	0	0	0	1	0	**1**
Cyperaceae	0	2	0	8	0	**10**
Rumex acetosa / sella	5	1	0	2	0	**8**
Trientalis europaea	3	0	0	0	0	**3**
Polypodium undiff.	2	0	0	0	0	**2**
Pteridium	0	0	0	1	0	**1**
Filicales undiff.	5	0	0	0	0	**5**
Total	**295**	**19**	**0**	**28**	**4**	**346**
Indeterminate	C1	4	0	9	3	**17**
Sphagnum						**98**
Lycopodium clavatum						**53**
Carbon frags.						**68**

Table 60 Methvern 334cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	0	1	**2**
Betula	19	1	0	2	0	**22**
Alnus	104	4	0	1	2	**111**
Quercus	4	1	0	3	1	**9**
Ulmus	18	2	0	3	1	**24**
Salix	1	0	0	0	0	**1**
Coryloid	88	1	0	7	0	**96**
Ericaceae	37	1	0	3	0	**41**
Gramineae	0	1	1	2	1	**5**
Cyperaceae	1	1	0	9	0	**11**
Ranunculus type	2	0	0	0	0	**2**
Rosaceae undiff.	2	0	0	0	0	**2**
Rumex acetosa / sella	6	0	0	0	0	**6**
Polypodium undiff.	2	0	0	0	0	**2**
Pteridium	1	0	0	0	0	**1**
Filicales undiff.	5	0	0	0	0	**5**
Total	**291**	**12**	**1**	**30**	**6**	**340**
Indeterminate	C2	1	0	8	0	**11**
Sphagnum						**8**
Lycopodium clavatum						**20**
Carbon frags.						**51**

Table 61 Methvern 336cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	0	1	0	0	0	**1**
Betula	17	1	0	1	1	**20**
Alnus	84	2	0	0	0	**86**
Quercus	10	0	0	1	0	**11**
Ulmus	18	1	0	6	0	**25**
Coryloid	93	2	0	2	2	**99**
Ericaceae	63	3	0	9	0	**75**
Gramineae	1	0	0	0	0	**1**
Cyperaceae	1	0	0	6	0	**7**
Filipendula	1	0	0	0	0	**1**
Rumex acetosa / sella	4	0	0	0	0	**4**
Pteridium	3	0	0	0	0	**3**
Filicales undiff.	2	0	0	0	0	**2**
Total	**297**	**10**	**0**	**25**	**3**	**335**
Indeterminate	C3	0	0	10	1	**14**
Sphagnum						**10**
Lycopodium clavatum						**12**
Tilletia sphagni						**2**
Carbon frags.						**41**

Table 62 Methvern 338cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	0	0	0	0	2	**2**
Betula	9	0	1	1	0	**11**
Alnus	98	1	1	4	5	**109**
Quercus	11	0	0	3	2	**16**
Ulmus	7	3	0	6	0	**16**
Tilia	2	0	0	0	0	**2**
Salix	1	0	0	0	0	**1**
Coryloid	124	5	2	4	1	**136**
Ericaceae	93	12	0	2	1	**108**
Cyperaceae	0	0	0	1	0	**1**
Ranunculus type	0	0	0	1	1	**2**
Rumex acetosa / sella	1	1	0	1	0	**3**
Polypodium undiff.	8	0	0	0	0	**8**
Filicales undiff.	8	1	0	0	2	**11**
Total	**362**	**23**	**4**	**23**	**14**	**426**
Indeterminate	C1	6	1	7	2	**17**
Sphagnum						**24**
Lycopodium clavatum						**1**
Carbon frags.						**63**

Table 63 Methvern 340cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	0	0	0	0	1	**1**
Betula	26	4	0	0	1	**31**
Alnus	93	4	0	2	6	**105**
Quercus	2	0	0	0	0	**2**
Ulmus	11	0	0	6	0	**17**
Salix	1	0	0	0	0	**1**
Coryloid	95	6	0	6	4	**111**
Ericaceae	87	10	0	11	1	**109**
Gramineae	0	0	0	2	0	. **2**
Cereal type	1	0	0	0	0	**1**
Cyperaceae	2	0	0	4	1	**7**
Ranunculus type	0	1	0	0	0	**1**
Rumex acetosa / sella	4	0	0	0	0	**4**
Trientalis europaea	5	0	0	0	0	**5**
Polypodium undiff.	4	0	0	0	0	**4**
Pteridium	2	0	0	0	0	**2**
Filicales undiff.	4	0	0	0	0	**4**
Total	**337**	**25**	**0**	**31**	**14**	**407**
Indeterminate	C6	4	0	16	7	**33**
Sphagnum						**347**
Lycopodium clavatum						**64**
Tilletia sphagni						**2**
Carbon frags.						**48**

Table 64 Methvern 342cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	0	0	0	0	1	**1**
Betula	18	0	0	0	1	**19**
Alnus	62	9	0	1	1	**73**
Quercus	3	0	0	4	0	**7**
Ulmus	15	2	0	5	3	**25**
Coryloid	91	7	0	1	3	**102**
Hedera helix	1	0	0	0	0	**1**
Ericaceae	41	14	0	0	0	**55**
Gramineae	2	2	0	1	1	**6**
Cyperaceae	0	1	0	2	0	**3**
Ranunculus type	3	1	0	0	0	**4**
Umbelliferae	1	1	0	0	0	**2**
Rumex acetosa / sella	2	0	0	0	0	**2**
Trientalis europaea	1	0	0	0	0	**1**
Compositae lig.	1	0	0	0	0	**1**
Pteridium	2	0	0	0	0	**2**
Filicales undiff.	3	0	0	0	0	**3**
Total	**246**	**37**	**0**	**14**	**10**	**307**
Indeterminate	C1	4	0	2	2	9
Sphagnum						**504**
Lycopodium clavatum						**106**
Tilletia sphagni						2
Carbon frags.						5

Table 65 Methvern 344cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	1	0	**2**
Betula	21	1	0	2	3	**27**
Alnus	59	9	0	3	5	**76**
Quercus	6	2	0	2	0	**10**
Ulmus	10	3	2	4	1	**20**
Coryloid	123	6	0	7	4	**140**
Hedera helix	1	0	0	0	0	**1**
Ericaceae	47	10	0	2	1	**60**
Gramineae	2	2	0	0	0	**4**
Cyperaceae	0	0	0	2	0	**2**
Ranunculus type	1	0	0	0	0	**1**
Umbelliferae	0	0	0	0	1	**1**
Rumex acetosa / sella	1	0	0	1	0	**2**
Trientalis europaea	2	0	0	0	0	**2**
Polypodium undiff.	4	0	0	0	0	**4**
Filicales undiff.	4	0	0	0	0	**4**
Total	**282**	**33**	**2**	**24**	**15**	**356**
Indeterminate	0	6	0	4	3	13
Sphagnum						**219**
Lycopodium clavatum						**44**
Tilletia sphagni						**1**
Carbon frags.						**9**

Table 66 Methvern 346cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	1	0	1	0	**3**
Betula	29	1	0	5	0	**35**
Alnus	94	9	0	2	2	**107**
Quercus	6	0	0	3	0	**9**
Ulmus	9	2	1	2	0	**14**
Salix	1	0	0	0	0	**1**
Coryloid	105	6	0	7	0	**118**
Hedera helix	1	0	0	0	0	**1**
Ericaceae	32	9	0	2	1	**44**
Gramineae	4	2	0	2	0	**8**
Rumex acetosa / sella	2	0	0	0	0	**2**
Trientalis europaea	1	0	0	0	0	**1**
Plantago lanceolata	1	0	0	0	0	**1**
Polypodium vulgare	2	0	0	0	0	**2**
Pteridium	2	0	0	0	0	**2**
Filicales undiff.	6	0	0	0	0	**6**
Total	**296**	**30**	**1**	**24**	**3**	**354**
Indeterminate	C4	11	0	10	0	**25**
Sphagnum						**84**
Lycopodium clavatum						**35**
Carbon frags.						**26**

Table 67 Methvern 348cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	0	0	0	1	2	**3**
Betula	29	2	0	1	0	**32**
Alnus	77	1	1	2	4	**83**
Quercus	6	0	0	4	0	**10**
Ulmus	13	0	0	8	1	**22**
Coryloid	110	5	0	6	4	**125**
Ericaceae	56	2	0	3	0	**61**
Gramineae	3	0	0	0	1	**4**
Ranunculus type	1	0	0	0	0	**1**
Rumex acetosa / sella	3	0	0	0	0	**3**
Urtica type	1	0	0	0	0	**1**
Polypodium undiff.	7	0	0	0	0	**7**
Pteridium	4	0	2	1	0	**7**
Filicales undiff.	5	0	0	0	0	**5**
Total	**315**	**10**	**3**	**26**	**12**	**364**
Indeterminate	C1	6	1	7	4	**19**
Sphagnum						**133**
Lycopodium clavatum						**30**
Carbon frags.						**13**

Table 68 Methvern 350cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	1	0	**2**
Betula	25	2	0	1	0	**28**
Alnus	91	10	0	2	1	**104**
Quercus	4	2	0	5	0	**11**
Ulmus	18	3	0	2	0	**23**
Salix	1	0	0	0	0	**1**
Coryloid	94	10	0	5	0	**109**
Ericaceae	30	5	0	5	0	**40**
Gramineae	2	3	0	1	0	**6**
Cyperaceae	0	1	0	1	0	**2**
Ranunculus type	3	0	0	0	0	**3**
Rosaceae undiff.	0	1	0	0	0	**1**
Filipendula	1	0	0	0	0	**1**
Rumex acetosa / sella	3	0	0	0	0	**3**
Urtica type	1	0	0	0	0	**1**
Polypodium vulgare	6	0	0	0	0	**6**
Filicales undiff.	5	0	0	0	0	**5**
Total	**285**	**37**	**0**	**23**	**1**	**346**
Indeterminate	0	4	0	11	0	**15**
Sphagnum						**48**
Lycopodium clavatum						**21**
Carbon frags.						**68**

Table 69 Methvern 352cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	0	0	0	0	1	**1**
Betula	20	0	0	0	2	**22**
Alnus	95	9	0	3	7	**114**
Quercus	11	1	0	6	1	**19**
Ulmus	12	0	0	6	0	**18**
Coryloid	84	5	0	6	1	**96**
Ericaceae	34	6	0	4	1	**45**
Gramineae	1	0	0	0	1	**2**
Cyperaceae	2	0	0	2	0	**4**
Ranunculus type	1	0	0	0	0	**1**
Filipendula	1	0	0	0	0	**1**
Rumex acetosa / sella	3	0	0	0	0	**3**
Urtica type	1	0	0	0	0	**1**
Pteridium	0	0	0	1	0	**1**
Filicales undiff.	7	0	0	0	0	**7**
Total	**272**	**21**	**0**	**28**	**14**	**335**
Indeterminate	C1	3	0	5	3	**12**
Sphagnum						**9**
Lycopodium clavatum						**10**
Carbon frags.						**64**

Table 70 Methvern 354cm						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	2	0	0	0	1	**3**
Betula	22	3	0	1	0	**26**
Alnus	92	6	0	4	2	**104**
Quercus	13	0	0	4	0	**17**
Ulmus	28	1	0	10	0	**39**
Coryloid	102	3	0	7	4	**116**
Hedera helix	1	0	0	0	0	**1**
Ericaceae	10	5	0	3	0	**18**
Gramineae	0	1	0	0	0	**1**
Cyperaceae	0	0	0	1	0	**1**
Rumex acetosa / sella	1	0	0	0	0	**1**
Trientalis europaea	1	0	0	0	0	**1**
Polypodium vulgare	4	0	0	1	0	**5**
Filicales undiff.	6	0	0	0	0	**6**
Total	**282**	**19**	**0**	**31**	**7**	**339**
Indeterminate	C5	5	0	10	0	**20**
Sphagnum						**4**
Lycopodium clavatum						**18**
Carbon frags.						**200**

Table 71 Methvern 356cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	3	0	0	0	2	**5**
Betula	18	2	0	2	1	**23**
Alnus	83	3	0	1	4	**91**
Quercus	8	3	0	0	1	**12**
Ulmus	18	3	0	5	2	**28**
Salix	2	0	0	0	0	**2**
Coryloid	96	2	0	8	4	**110**
Ericaceae	18	3	0	1	0	**22**
Gramineae	3	0	0	0	2	**5**
Cyperaceae	0	1	0	8	0	**9**
Ranunculus type	0	0	0	1	0	**1**
Rumex acetosa / sella	4	0	0	0	0	**4**
Pteridium	1	0	0	1	0	**2**
Filicales undiff.	8	0	0	0	1	**9**
Total	**262**	**17**	**0**	**27**	**17**	**323**
Indeterminate	C3	4	0	6	1	**14**
Sphagnum						**19**
Lycopodium clavatum						**33**
Carbon frags.						**76**

Table 72 Methvern 358cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	0	0	**1**
Betula	27	3	0	0	0	**30**
Alnus	84	3	0	0	4	**91**
Quercus	10	2	0	5	2	**19**
Ulmus	17	5	0	4	0	**26**
Coryloid	98	3	0	1	2	**105**
Ericaccac	13	4	0	2	0	**19**
Gramineae	0	5	0	4	0	**9**
Cyperaccac	0	1	0	6	0	**7**
Ranunculus type	1	0	0	0	0	**1**
Rosaccac undiff.	1	0	0	0	0	**1**
Filipendula	0	1	0	0	0	**1**
Rumex acetosa / sella	3	1	0	1	0	**5**
Polypodium vulgare	2	0	0	0	0	**2**
Pteridium	2	0	0	0	0	**2**
Filicales undiff.	10	0	0	0	1	**11**
Total	**269**	**28**	**0**	**23**	**9**	**330**
Indeterminate	C1	4	0	5	3	**13**
Sphagnum						**107**
Lycopodium clavatum						**43**
Carbon frags.						**36**

Table 73 Methvern 360cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	0	1	0	1	1	**3**
Betula	18	4	0	3	0	**25**
Alnus	98	5	0	1	4	**108**
Quercus	7	0	0	0	1	**8**
Ulmus	13	2	0	6	0	**21**
Coryloid	98	9	0	3	1	**111**
Ericaceae	19	5	0	0	0	**24**
Gramineae	0	1	0	0	0	**1**
Cyperaceae	0	3	0	4	0	**7**
Ranunculus type	1	0	0	0	1	**2**
Rosaceae undiff.	1	0	0	0	0	**1**
Filipendula	1	0	0	0	0	**1**
Rumex acetosa / sella	3	0	0	0	1	**4**
Polypodium undiff.	2	0	0	1	0	**3**
Pteridium	1	1	0	1	0	**3**
Filicales undiff.	3	0	0	0	0	**3**
Total	**265**	**31**	**0**	**20**	**9**	**325**
Indeterminate	C2	7	1	4	1	**15**
Sphagnum						**59**
Lycopodium clavatum						**56**
Carbon frags.						**32**

Table 74 Methvern 362cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	0	1	**2**
Betula	23	3	0	1	1	**28**
Alnus	61	13	0	1	4	**79**
Quercus	4	2	0	7	0	**13**
Ulmus	18	6	0	5	0	**29**
Coryloid	117	13	0	3	0	**133**
Ericaceae	21	9	0	1	0	**31**
Gramineae	2	2	0	2	0	**6**
Rumex acetosa / sella	2	0	0	0	0	**2**
Filicales undiff.	10	1	0	0	0	**11**
Total	**259**	**49**	**0**	**20**	**6**	**334**
Indeterminate	0	6	0	9	0	**15**
Sphagnum						**14**
Lycopodium clavatum						**40**
Carbon frags.						**37**

Table 75 Methvern 364cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	0	1	**2**
Betula	15	2	0	3	1	**21**
Alnus	95	2	1	2	7	**107**
Quercus	5	1	0	3	0	**9**
Ulmus	15	2	0	5	0	**22**
Coryloid	103	4	0	4	3	**114**
Ericaceae	42	3	0	5	1	**51**
Gramineae	1	0	0	1	0	**2**
Cyperaceae	0	2	0	2	0	**4**
Chenopodiaceae	1	0	0	0	0	**1**
Rumex acetosa / sella	4	1	0	1	0	**6**
Urtica type	1	0	0	1	0	**2**
Polypodium undiff.	5	0	0	0	0	**5**
Pteridium	1	0	0	0	0	**1**
Filicales undiff.	4	1	0	0	0	**5**
Total	**293**	**18**	**1**	**27**	**13**	**352**
Indeterminate	C1	5	0	11	2	**19**
Sphagnum						**2**
Lycopodium clavatum						**18**
Carbon frags.						**23**

Table 76 Methvern 366cm						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	1	0	**2**
Betula	19	2	0	4	4	**29**
Alnus	80	13	0	4	3	**100**
Quercus	3	1	0	7	0	**11**
Ulmus	13	5	0	6	0	**24**
Coryloid	109	9	0	4	2	**124**
Ericaceae	56	6	0	2	0	**64**
Gramineae	0	2	0	0	0	**2**
Cyperaceae	0	0	0	3	0	**3**
Ranunculus type	1	0	0	0	0	**1**
Umbelliferae	1	0	0	0	0	**1**
Rumex acetosa / sella	1	1	0	0	0	**2**
Compositae lig.	2	0	0	0	0	**2**
Polypodium vulgare	2	0	0	0	0	**2**
Filicales undiff.	4	1	0	0	0	**5**
Total	**292**	**40**	**0**	**31**	**9**	**372**
Indeterminate	C1	5	1	8	0	**15**
Sphagnum						**25**
Lycopodium clavatum						**53**
Carbon frags.						**87**

Table 77 Methvern 368cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Betula	18	1	0	1	1	**21**
Alnus	55	2	1	0	8	**66**
Quercus	14	1	0	0	0	**15**
Ulmus	13	0	0	1	1	**15**
Coryloid	114	6	0	7	6	**133**
Ericaceae	48	20	0	1	0	**69**
Gramineae	0	0	0	0	3	**3**
Ranunculus type	4	0	0	0	0	**4**
Rumex acetosa / sella	4	0	0	0	1	**5**
Viburnum opulus	1	0	0	0	0	**1**
Polypodium undiff.	5	0	0	0	0	**5**
Filicales undiff.	6	0	0	0	0	**6**
Total	**282**	**30**	**1**	**10**	**20**	**343**
Indeterminate	C1	1	0	7	4	**13**
Sphagnum						**813**
Lycopodium clavatum						**89**
Carbon frags.						**9**

Table 78 Methvern 370cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	2	2	0	0	1	**5**
Betula	25	1	1	1	1	**29**
Alnus	74	14	0	2	0	**90**
Quercus	1	2	0	5	0	**8**
Ulmus	11	3	0	4	1	**19**
Coryloid	87	14	0	2	3	**106**
Ericaceae	32	2	0	2	0	**36**
Gramineae	2	9	1	2	0	**14**
Cyperaceae	0	0	0	2	0	**2**
Umbelliferae	3	0	0	0	0	**3**
Rumex acetosa / sella	1	0	0	0	0	**1**
Polypodium vulgare	3	0	0	0	0	**3**
Pteridium	3	1	0	0	0	**4**
Filicales undiff.	17	1	0	0	0	**18**
Total	**261**	**49**	**2**	**20**	**6**	**338**
Indeterminate	2	8	0	4	2	**16**
Sphagnum						**949**
Lycopodium clavatum						**169**
Carbon frags.						**8**

Table 79 Methvern 372cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Betula	22	2	0	3	2	**29**
Alnus	97	4	0	0	8	**109**
Quercus	8	0	0	1	0	**9**
Ulmus	14	1	0	7	2	**24**
Coryloid	101	5	0	4	3	**113**
Ericaceae	54	1	0	5	2	**62**
Gramineae	2	1	0	0	0	**3**
Cyperaceae	0	0	0	2	0	**2**
Ranunculus type	2	0	0	0	0	**2**
Rosaceae undiff.	1	0	0	0	0	**1**
Rumex acetosa / sella	1	0	0	0	0	**1**
Urtica type	1	0	0	0	0	**1**
Filicales undiff.	7	0	0	0	1	**8**
Total	**310**	**14**	**0**	**22**	**18**	**364**
Indeterminate	C1	2	0	3	7	**13**
Sphagnum						**197**
Lycopodium clavatum						**18**
Carbon frags.						**103**

Table 80 Methvern 374cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	2	0	0	1	**4**
Betula	31	8	0	1	2	**42**
Alnus	67	11	0	0	1	**79**
Quercus	3	2	0	5	0	**10**
Ulmus	7	3	0	5	0	**15**
Salix	1	0	0	0	0	**1**
Coryloid	94	9	0	6	5	**114**
Ericaceae	30	6	0	1	0	**37**
Gramineae	0	12	0	8	1	**21**
Cyperaceae	0	2	0	9	0	**11**
Ranunculus type	1	0	0	1	0	**2**
Rumex acetosa / sella	1	2	0	0	0	**3**
Filicales undiff.	4	2	0	0	1	**7**
Total	**240**	**59**	**0**	**36**	**11**	**346**
Indeterminate	C2	4	0	6	1	**13**
Sphagnum						**63**
Lycopodium clavatum						**68**
Tilletia sphagni						**2**
Carbon frags.						**81**

Table 81 Methvern 376cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	0	1	0	0	2	**3**
Betula	28	1	0	0	1	**30**
Alnus	78	9	0	1	8	**96**
Quercus	2	1	0	1	1	**5**
Ulmus	6	1	0	5	0	**12**
Coryloid	113	7	0	6	3	**129**
Ericaceae	76	11	0	12	3	**102**
Cyperaceae	0	0	0	4	0	**4**
Ranunculus type	1	0	0	0	0	**1**
Filipendula	1	0	0	0	0	**1**
Rumex acetosa / sella	2	0	0	0	0	**2**
Urtica type	2	0	0	0	0	**2**
Compositae lig.	1	0	0	0	0	**1**
Polypodium vulgare	3	0	0	0	0	**3**
Pteridium	2	0	0	0	0	**2**
Filicales undiff.	9	0	0	0	0	**9**
Total	**324**	**31**	**0**	**29**	**18**	**402**
Indeterminate	C2	3	0	6	7	**18**
Sphagnum						**98**
Lycopodium clavatum						**19**
Tilletia sphagni						**22**
Carbon frags.						**63**

Table 82 Methvern 378cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	0	1	**2**
Betula	19	5	0	1	2	**27**
Alnus	54	9	0	8	1	**72**
Quercus	3	3	0	7	0	**13**
Ulmus	14	1	0	7	1	**23**
Salix	1	0	0	0	0	**1**
Coryloid	112	14	0	6	3	**135**
Ericaceae	55	11	0	8	0	**74**
Gramineae	1	7	0	3	0	**11**
Cyperaceae	0	1	0	7	0	**8**
Ranunculus type	1	0	0	0	0	**1**
Rumex acetosa / sella	1	0	0	0	0	**1**
Polypodium vulgare	1	0	0	0	0	**1**
Filicales undiff.	4	0	0	0	0	**4**
Total	**267**	**51**	**0**	**47**	**8**	**373**
Indeterminate	C2	5	1	6	2	**16**
Sphagnum						**61**
Lycopodium clavatum						**56**
Tilletia sphagni						**2**
Carbon frags.						**32**

Table 83 Methvern 380cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	0	0	0	0	1	**1**
Betula	50	7	0	3	6	**66**
Alnus	71	11	0	0	7	**89**
Quercus	9	0	0	2	0	**11**
Ulmus	12	4	0	6	1	**23**
Coryloid	83	3	0	10	2	**98**
Ericaceae	31	2	0	3	0	**36**
Gramineae	1	1	0	0	0	**2**
Cyperaceae	1	2	0	8	0	**11**
Rumex acetosa / sella	3	0	0	2	0	**5**
Urtica type	2	0	0	0	0	**2**
Polypodium vulgare	3	0	0	0	0	**3**
Pteridium	0	0	0	1	0	**1**
Filicales undiff.	6	1	0	0	0	**7**
Total	**272**	**31**	**0**	**35**	**17**	**355**
Indeterminate	C5	7	0	5	6	**23**
Sphagnum						**14**
Lycopodium clavatum						**5**
Carbon frags.						**42**

Table 84 Methvern 382cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	3	0	0	0	0	**3**
Betula	134	9	0	3	2	**148**
Alnus	47	2	0	2	1	**52**
Quercus	6	1	0	4	1	**12**
Ulmus	10	4	0	3	1	**18**
Coryloid	59	2	0	4	2	**67**
Ericaceae	4	0	0	2	0	**6**
Gramineae	0	0	0	1	1	**2**
Cyperaceae	0	0	0	2	0	**2**
Ranunculus type	2	0	0	1	0	**3**
Rumex acetosa / sella	3	0	0	0	0	**3**
Polypodium undiff.	1	0	0	0	0	**1**
Filicales undiff.	3	0	0	0	0	**3**
Total	**272**	**18**	**0**	**22**	**8**	**320**
Indeterminate	C1	5	1	7	0	**14**
Lycopodium clavatum						**1**
Carbon frags.						**4**

Table 85 Methvern 384cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	2	0	0	0	0	**2**
Betula	91	3	0	3	5	**102**
Alnus	60	3	1	1	1	**66**
Quercus	4	1	0	1	0	**6**
Ulmus	6	1	1	5	0	**13**
Coryloid	92	2	0	6	3	**103**
Ericaceae	2	0	0	0	0	**2**
Gramineae	3	0	0	0	0	**3**
Cyperaceae	0	1	0	2	0	**3**
Umbelliferae	1	0	0	0	0	**1**
Rumex acetosa / sella	3	0	0	0	0	**3**
Succisa pratensis	1	0	0	0	0	**1**
Polypodium undiff.	2	0	0	0	0	**2**
Filicales undiff.	7	1	0	1	1	**10**
Total	**274**	**12**	**2**	**19**	**10**	**317**
Indeterminate	C2	0	0	7	3	**12**
Sphagnum						**5**
Lycopodium clavatum						**11**
Carbon frags.						**4**

Table 86 Methvern 386cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	1	3	**5**
Betula	152	6	0	0	1	**159**
Alnus	47	0	1	0	4	**52**
Quercus	0	0	0	2	1	**3**
Ulmus	9	1	0	2	0	**12**
Salix	1	0	0	0	0	**1**
Coryloid	38	4	0	0	1	**43**
Gramineae	12	1	0	0	2	**15**
Filicales undiff.	20	2	0	0	4	**26**
Total	**280**	**14**	**1**	**5**	**16**	**316**
Indeterminate	C2	7	0	1	2	**12**
Lycopodium clavatum						**8**

Table 87 Methvern 388cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	0	0	0	1	1	**2**
Betula	125	15	6	2	6	**154**
Alnus	50	6	10	0	2	**68**
Quercus	5	0	0	0	0	**5**
Ulmus	1	1	0	2	0	**4**
Coryloid	32	19	2	1	0	**54**
Ericaceae	7	1	0	0	0	**8**
Gramineae	5	3	0	4	0	**12**
Rosaceae undiff.	2	0	0	0	0	**2**
Umbelliferae	2	0	0	0	0	**2**
Rumex acetosa / sella	1	0	0	0	0	**1**
Succisa pratensis	1	0	0	0	0	**1**
Polypodium undiff.	2	0	0	0	0	**2**
Filicales undiff.	52	3	0	0	4	**59**
Total	**285**	**48**	**18**	**10**	**13**	**374**
Indeterminate	0	7	6	3	2	**18**
Sphagnum						**5**
Lycopodium clavatum						**2**
Carbon frags.						**2**

Table 88 Methvern 390cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	4	1	0	0	4	**9**
Betula	41	18	2	5	0	**66**
Alnus	22	13	6	1	2	**44**
Quercus	2	3	1	1	0	**7**
Ulmus	5	4	0	9	0	**18**
Coryloid	25	26	0	7	1	**59**
Ericaceae	1	0	0	0	0	**1**
Gramineae	6	9	0	7	0	**22**
Cyperaceae	3	1	0	4	0	**8**
Filipendula	1	0	0	0	0	**1**
Umbelliferae	1	0	0	0	0	**1**
Galium type	0	0	0	0	1	**1**
Polypodium undiff.	2	0	0	0	0	**2**
Pteridium	0	0	0	1	0	**1**
Filicales undiff.	72	7	0	0	12	**91**
Dryopteris undiff.	1	0	0	0	0	**1**
Total	**186**	**82**	**9**	**35**	**20**	**332**
Indeterminate	C2	6	4	2	1	**15**
Sphagnum						**9**
Lycopodium clavatum						**40**
Carbon frags.						**8**

Table 89 Methvern 392cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	0	0	2	**3**
Betula	105	6	1	7	1	**120**
Alnus	36	4	2	0	2	**44**
Quercus	1	0	0	0	0	**1**
Ulmus	7	0	0	1	1	**9**
Tilia	1	0	0	0	0	**1**
Salix	1	0	0	0	0	**1**
Coryloid	38	12	2	3	1	**56**
Ericaceae	6	0	0	0	0	**6**
Gramineae	2	0	1	3	1	**7**
Cyperaceae	0	4	0	3	0	**7**
Ranunculus type	1	0	0	0	0	**1**
Rosaceae undiff.	1	0	0	0	0	**1**
Filipendula	1	0	0	0	0	**1**
Umbelliferae	1	0	0	0	0	**1**
Rumex acetosa / sella	1	0	0	0	0	**1**
Urtica type	1	0	0	0	0	**1**
Galium type	1	0	0	0	0	**1**
Compositae lig.	0	0	0	0	1	**1**
Compositae tub.	1	0	0	0	0	**1**
Polypodium vulgare	3	0	0	0	0	**3**
Pteridium	2	0	0	0	0	**2**
Filicales undiff.	49	4	0	2	5	**60**
Total	**260**	**30**	**6**	**19**	**14**	**329**
Indeterminate	C1	6	5	4	3	**19**
Sphagnum						**8**
Lycopodium clavatum						**29**
Carbon frags.						**22**

Table 90 Methvern 394cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	1	0	0	0	**2**
Betula	38	6	1	2	1	**48**
Alnus	33	9	3	1	1	**47**
Quercus	3	0	0	2	0	**5**
Ulmus	5	0	0	1	0	**6**
Coryloid	32	6	0	9	0	**47**
Ericaceae	3	0	0	0	0	**3**
Gramineae	10	2	1	5	3	**21**
Cyperaceae	1	0	0	2	0	**3**
Umbelliferae	1	0	0	0	0	**1**
Rumex acetosa / sella	2	0	0	0	0	**2**
Polypodium vulgare	2	0	0	0	0	**2**
Filicales undiff.	78	22	2	0	15	**117**
Dryopteris undiff.	1	0	0	0	0	**1**
Total	**210**	**46**	**7**	**22**	**20**	**305**
Indeterminate	0	1	0	2	1	**4**
Sphagnum						**4**
Lycopodium clavatum						**69**
Carbon frags.						**205**

Table 91 Methvern 396cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	2	2	0	2	1	7
Betula	14	4	1	3	1	**23**
Alnus	33	6	3	5	3	**50**
Quercus	1	2	0	1	0	**4**
Ulmus	1	0	0	3	0	**4**
Salix	1	0	0	0	0	**1**
Coryloid	24	5	0	5	1	**35**
Gramineae	4	9	1	5	1	**20**
Cyperaceae	1	1	0	0	10	**12**
Ranunculus type	1	0	0	0	0	**1**
Rosaceae undiff.	1	0	0	0	0	**1**
Filipendula	1	0	0	0	0	**1**
Umbelliferae	1	0	0	0	0	**1**
Compositae lig.	3	0	0	0	0	**3**
Polypodium vulgare	2	0	0	0	0	**2**
Filicales undiff.	82	45	2	2	5	**136**
Total	**172**	**74**	**7**	**26**	**22**	**301**
Indeterminate	C4	5	3	6	0	**18**
Sphagnum						**2**
Lycopodium clavatum						**47**
Carbon frags.						**26**

Table 92 Methvern 398cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	8	0	0	0	5	**13**
Betula	34	4	1	6	3	**48**
Alnus	32	2	1	2	2	**39**
Quercus	0	0	0	6	0	**6**
Ulmus	0	0	0	6	0	**6**
Salix	2	0	0	0	0	**2**
Coryloid	49	7	3	9	2	**70**
Ericaceae	3	0	0	0	0	**3**
Gramineae	19	6	1	17	2	**45**
Cyperaceae	0	1	0	12	0	**13**
Rosaceae undiff.	1	0	0	0	0	**1**
Filipendula	1	0	0	0	0	**1**
Rumex acetosa / sella	0	0	0	0	2	**2**
Plantago media / major	1	0	0	0	0	**1**
Compositae lig.	1	0	0	0	0	**1**
Polypodium vulgare	1	0	0	0	0	**1**
Filicales undiff.	38	4	0	0	14	**56**
Total	**190**	**24**	**6**	**58**	**30**	**308**
Indeterminate	C1	5	5	3	1	**15**
Sphagnum						**9**
Lycopodium clavatum						**60**
Carbon frags.						**51**

Table 93 Methvern 400cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	6	1	0	3	3	**13**
Betula	34	1	0	3	0	**38**
Alnus	30	0	0	0	1	**31**
Quercus	6	2	0	0	0	**8**
Ulmus	7	1	0	2	0	**10**
Coryloid	67	14	0	0	4	**85**
Ericaceae	18	4	0	1	1	**24**
Gramineae	12	3	0	3	1	**16**
Cyperaceae	4	4	0	11	0	**19**
Caryophyllaceae	1	0	0	0	0	**1**
Rosaceae undiff.	1	0	0	0	1	**2**
Filipendula	1	0	0	0	0	**1**
Rumex acetosa / sella	1	0	0	0	0	**1**
Urtica type	1	0	0	0	0	**1**
Trientalis europaea	1	0	0	0	0	**1**
Plantago lanceolata	1	0	0	0	0	**1**
Lycopodium inundatum	1	0	0	0	0	**1**
Polypodium vulgare	3	0	0	0	0	**3**
Pteridium	0	0	0	0	3	**3**
Filicales undiff.	43	8	0	0	5	**56**
Total	**238**	**38**	**0**	**23**	**19**	**315**
Indeterminate	C3	6	2	3	0	**14**
Sphagnum						**21**
Lycopodium clavatum						**45**
Tilletia sphagni						**1**
Carbon frags.						**38**

Table 94 Methvern 404cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	8	1	0	5	4	**18**
Betula	8	3	1	7	0	**19**
Alnus	3	3	0	0	0	**6**
Quercus	1	0	0	3	0	**4**
Ulmus	2	0	0	2	0	**4**
Coryloid	16	7	1	7	1	**32**
Ericaceae	2	1	0	0	0	**3**
Gramineae	17	10	0	15	2	**44**
Cyperaceae	0	0	0	1	0	**1**
Ranunculus type	2	0	0	0	1	**3**
Caryophyllaceae	1	0	0	0	0	**1**
Polypodium undiff.	3	0	0	0	0	**3**
Thelypteris undiff.	20	2	0	0	0	**22**
Filicales undiff.	39	96	4	0	7	**146**
Dryopteris undiff.	1	0	0	0	0	**1**
Total	**123**	**123**	**6**	**40**	**15**	**307**
Indeterminate	C2	8	1	5	1	**17**
Sphagnum						**7**
Lycopodium clavatum						**87**
Carbon frags.						**6**

Table 95 Methvern 408cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	6	3	2	1	3	**15**
Betula	10	3	0	4	0	**17**
Alnus	4	0	0	0	0	**4**
Quercus	2	1	0	1	0	**4**
Ulmus	6	1	0	5	0	**12**
Tilia	1	0	0	0	0	**1**
Salix	1	0	0	0	0	**1**
Coryloid	46	26	2	7	2	**83**
Gramineae	38	10	2	25	3	**78**
Cyperaceae	0	1	0	5	0	**6**
Montia fontana	1	0	0	0	0	**1**
Filipendula	1	0	0	0	0	**1**
Urtica type	3	0	0	0	0	**3**
Taraxacum	1	0	0	0	0	**1**
Polypodium vulgare	3	0	0	0	0	**3**
Pteridium	1	0	0	0	0	**1**
Thelypteris undiff.	2	0	0	0	0	**2**
Filicales undiff.	39	41	1	1	6	**88**
Total	**165**	**86**	**7**	**49**	**14**	**321**
Indeterminate	C4	11	5	12	0	**32**
Lycopodium clavatum						**119**
Carbon frags.						**6**

Table 96 Methvern 416cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	2	5	0	4	3	**14**
Betula	11	6	0	4	0	**21**
Alnus	2	0	0	0	0	**2**
Quercus	7	1	0	6	0	**14**
Ulmus	7	0	0	3	0	**10**
Tilia	1	0	0	0	0	**1**
Coryloid	39	39	0	10	3	**91**
Ericaceae	1	0	0	0	0	**1**
Gramineae	46	24	1	19	6	**96**
Cyperaceae	0	7	0	2	0	**9**
Ranunculus type	1	0	0	0	0	**1**
Rumex acetosa / sella	1	0	0	0	0	**1**
Trientalis europaea	1	0	0	0	0	**1**
Polypodium vulgare	1	1	0	0	0	**2**
Pteridium	1	0	0	0	0	**1**
Filicales undiff.	27	4	0	0	4	**35**
Total	**148**	**87**	**1**	**48**	**16**	**300**
Indeterminate	0	9	1	5	0	15
Sphagnum						6
Lycopodium clavatum						96
Carbon frags.						5

Table 97 Methvern 424cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	5	1	0	6	6	**18**
Betula	10	17	3	1	2	**33**
Alnus	1	1	0	0	0	**2**
Quercus	4	0	0	0	0	**4**
Ulmus	2	3	1	2	0	**8**
Coryloid	28	21	0	8	0	**57**
Gramineae	5	12	0	21	3	**41**
Cyperaceae	10	14	0	15	0	**39**
Rumex acetosa / sella	1	0	0	0	0	**1**
Polypodium undiff.	1	0	0	0	0	**1**
Pteridium	2	0	0	0	0	**2**
Filicales undiff.	145	15	0	3	26	**189**
Total	**214**	**84**	**4**	**56**	**37**	**395**
Indeterminate	0	16	2	5	4	27
Lycopodium clavatum						47

Table 98 Methvern 432cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	24	2	0	0	11	**37**
Betula	8	3	0	0	0	**11**
Alnus	1	0	0	0	0	**1**
Ulmus	3	2	0	3	1	**9**
Coryloid	6	6	0	2	0	**14**
Gramineae	10	24	0	6	0	**40**
Cyperaceae	27	26	0	37	0	**91**
Saxifraga	1	0	0	0	0	**1**
Gentianella campestris	1	0	0	0	0	**1**
Polypodium vulgare	1	0	0	0	0	**1**
Pteridium	1	0	0	1	0	**2**
Filicales undiff.	78	1	0	1	12	**92**
Total	**161**	**64**	**0**	**50**	**24**	**300**
Indeterminate	C1	7	0	2	0	**10**
Lycopodium clavatum						**45**
Carbon frags.						**1**

Table 99 Methvern 440cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	1	0	4	5	**18**
Betula	21	22	0	3	1	**47**
Alnus	0	1	0	0	0	**1**
Quercus	3	1	0	0	0	**4**
Ulmus	0	1	0	3	0	**4**
Salix	1	0	0	0	0	**1**
Coryloid	2	10	0	1	0	**13**
Ericaceae	1	0	0	0	0	**1**
Gramineae	15	48	0	24	0	**87**
Cyperaceae	5	26	0	58	0	**84**
Filipendula	3	1	0	0	0	**4**
Saxifraga	0	1	0	0	0	**1**
Rumex acetosa / sella	2	1	0	1	0	**4**
Polypodium vulgare	1	0	0	0	0	**1**
Pteridium	1	0	0	0	0	**1**
Filicales undiff.	16	1	0	1	10	**28**
Dryopteris undiff.	1	0	0	0	0	**1**
Total	**73**	**114**	**0**	**95**	**16**	**300**
Sphagnum	2	0	0	0	0	**2**
Indeterminate	C2	18	0	4	0	**24**
Lycopodium clavatum						**85**
Carbon frags.						**73**

Table 100 Methvern 448cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	20	4	0	5	6	**39**
Betula	21	10	0	5	1	**37**
Alnus	2	0	0	0	0	**2**
Quercus	4	6	0	3	0	**13**
Ulmus	0	5	0	1	0	**6**
Salix	2	0	0	0	0	**2**
Coryloid	15	19	0	3	0	**37**
Gramineae	17	42	0	9	2	**70**
Cyperaceae	8	28	0	15	1	**52**
Ranunculus type	1	1	0	0	0	**2**
Rosaceae undiff.	0	1	0	0	0	**1**
Rumex acetosa / sella	0	1	0	0	0	**1**
Artemisia	1	0	0	0	0	**1**
Polypodium undiff.	6	0	0	0	0	**6**
Pteridium	2	0	0	1	0	**3**
Thelypteris undiff.	1	0	0	0	0	**1**
Filicales undiff.	19	3	0	0	8	**30**
Total	**119**	**120**	**0**	**42**	**18**	**303**
Indeterminate	C3	14	0	2	2	**21**
Lycopodium clavatum						**90**
Carbon frags.						**22**

Table 101 Methvern 456cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	17	5	2	1	9	**34**
Betula	17	28	0	3	0	**48**
Alnus	1	0	0	1	0	**2**
Quercus	5	1	0	1	0	**7**
Ulmus	3	5	0	3	0	**11**
Salix	3	0	0	0	0	**3**
Coryloid	22	29	0	3	0	**54**
Ericaceae	1	0	0	0	0	**1**
Gramineae	35	56	0	20	2	**113**
Cyperaceae	5	7	0	6	1	**20**
Ranunculus type	1	0	0	0	0	**1**
Rumex acetosa / sella	4	4	0	0	0	**8**
Trientalis europaea	1	0	0	0	0	**1**
Polypodium undiff.	1	0	0	0	0	**1**
Pteridium	0	0	0	0	1	**1**
Filicales undiff.	6	2	0	0	5	**13**
Total	**122**	**137**	**2**	**38**	**18**	**318**
Indeterminate	C2	22	0	8	1	**33**
Lycopodium clavatum						**70**
Carbon frags.						**47**

Table 102 Methvern 464cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	12	3	0	2	6	**23**
Betula	12	13	0	4	1	**30**
Alnus	0	2	0	0	0	**2**
Quercus	3	4	0	0	0	**7**
Ulmus	1	3	0	1	0	**5**
Salix	3	0	0	0	0	**3**
Coryloid	23	41	0	4	1	**69**
Gramineae	29	37	0	13	0	**79**
Cyperaceae	5	23	0	11	0	**39**
Ranunculus type	2	0	0	0	0	**2**
Rosaceae undiff.	1	0	0	0	0	**1**
Rumex acetosa / sella	1	3	0	0	0	**4**
Pteridium	1	1	0	1	0	**3**
Filicales undiff.	18	5	0	0	10	**33**
Total	**111**	**135**	**0**	**36**	**18**	**300**
Sphagnum	2	0	0	0	0	**2**
Indeterminate	0	15	0	2	1	**18**
Lycopodium clavatum						**50**
Carbon frags.						**78**

Table 103 Methvern 472cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	9	5	0	5	0	**19**
Betula	28	7	2	0	0	**37**
Alnus	0	1	0	0	0	**1**
Quercus	6	2	0	0	0	**8**
Ulmus	4	2	0	0	0	**6**
Salix	3	1	0	0	0	**4**
Coryloid	20	35	0	4	0	**60**
Ericaceae	0	0	0	0	0	**1**
Gramineae	35	59	0	8	3	**105**
Cyperaceae	21	11	0	1	2	**35**
Ranunculus type	0	0	0	0	0	**1**
Saxifraga	0	0	0	0	0	**1**
Rumex acetosa / sella	0	0	0	0	0	**1**
Pteridium	0	0	0	0	0	**1**
Filicales undiff.	3	2	0	0	15	**20**
Total	**119**	**125**	**2**	**18**	**36**	**300**
Sphagnum	1	0	0	0	0	**1**
Indeterminate	0	20	0	4	8	**32**
Lycopodium clavatum						**64**
Pediastrum						**1**
Carbon frags.						**25**

Table 104 Methvern 480cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	6	1	0	1	6	**14**
Betula	16	16	1	8	1	**42**
Alnus	1	0	0	0	0	**1**
Quercus	6	0	0	2	0	**8**
Ulmus	2	2	0	1	0	**5**
Salix	4	0	0	0	0	**4**
Coryloid	25	22	0	4	1	**52**
Ericaceae	0	1	0	0	0	**1**
Gramineae	39	48	1	33	3	**124**
Cyperaceae	5	9	0	16	2	**32**
Ranunculus type	0	1	0	0	0	**1**
Saxifraga	1	0	0	0	0	**1**
Rumex acetosa / sella	0	2	0	0	0	**2**
Filicales undiff.	2	1	0	0	12	**15**
Total	**107**	**103**	**2**	**65**	**25**	**302**
Sphagnum	1	0	0	0	0	**1**
Indeterminate	C1	18	1	8	6	**34**
Lycopodium clavatum						**80**
Pediastrum						**3**
Carbon frags.						**23**

Table 105 Methvern 488cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	5	5	0	0	0	**10**
Betula	14	26	0	9	0	**49**
Alnus	1	0	0	0	0	**1**
Quercus	5	0	0	0	0	**5**
Ulmus	7	1	0	0	0	**8**
Salix	3	0	0	0	0	**3**
Coryloid	32	32	0	15	0	**79**
Ericaceae	1	0	0	0	0	**1**
Gramineae	31	45	2	20	0	**98**
Cyperaceae	8	4	0	16	0	**28**
Saxifraga	1	0	0	0	0	**1**
Rumex acetosa / sella	1	0	0	0	0	**1**
Compositae lig.	1	0	0	0	0	**1**
Filicales undiff.	4	10	0	0	1	**15**
Total	**114**	**123**	**2**	**60**	**1**	**300**
Sphagnum	4	0	0	0	0	**4**
Indeterminate	C3	12	5	3	2	**25**
Lycopodium clavatum						**53**
Carbon frags.						**20**

Table 106 Methvern 496cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	2	0	1	2	4	**9**
Betula	34	25	1	6	2	**68**
Alnus	2	0	0	0	0	**2**
Quercus	1	0	0	1	0	**2**
Ulmus	4	4	0	1	0	**9**
Coryloid	28	42	1	7	1	**79**
Ericaceae	1	0	0	0	0	**1**
Gramineae	25	40	3	25	2	**95**
Cyperaceae	2	12	1	10	0	**25**
Rosaceae undiff.	1	0	0	0	0	**1**
Rumex acetosa / sella	3	1	0	0	0	**4**
Compositae lig.	1	0	0	0	0	**1**
Filicales undiff.	6	1	0	3	4	**14**
Total	**110**	**125**	**7**	**55**	**13**	**310**
Sphagnum	6	0	0	0	0	**6**
Indeterminate	C4	9	4	6	0	**23**
Menyanthes trifoliata	1	0	0	0	0	**1**
Scheuchzeria palustris	1	0	0	0	0	**1**
Lycopodium clavatum						**49**
Carbon frags.						**19**

Table 107 Methvern 502cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	2	2	0	6	0	**10**
Betula	20	24	0	11	0	**55**
Alnus	0	0	1	0	0	**1**
Quercus	0	0	1	0	0	**1**
Ulmus	2	1	2	3	0	**8**
Coryloid	40	34	0	20	0	**94**
Gramineae	34	40	0	20	0	**94**
Cyperaceae	4	6	0	10	0	**20**
Filipendula	1	0	0	0	0	**1**
Umbelliferae	0	1	0	0	0	**1**
Rumex acetosa / sella	1	0	0	0	0	**1**
Compositae lig.	1	0	0	0	0	**1**
Thelypteris undiff.	1	0	0	0	0	**1**
Filicales undiff.	3	3	2	5	0	**13**
Total	**109**	**111**	**6**	**75**	**0**	**301**
Sphagnum	2	0	0	0	0	**2**
Indeterminate	C1	10	5	2	0	**18**
Lycopodium clavatum						**58**
Carbon frags.						**20**

Table 108 Methvern 508cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	2	1	1	0	2	**6**
Betula	11	15	1	12	0	**39**
Alnus	2	0	0	0	0	**2**
Quercus	1	0	0	0	0	**1**
Ulmus	2	1	0	2	1	**6**
Salix	1	0	0	0	0	**1**
Coryloid	46	50	0	17	1	**114**
Gramineae	22	27	4	42	1	**96**
Cyperaceae	1	9	1	6	0	**17**
Filipendula	1	0	0	0	0	**1**
Saxifraga	1	0	0	0	0	**1**
Umbelliferae	1	0	0	0	0	**1**
Rumex acetosa / sella	2	0	0	0	0	**2**
Pteridium	1	0	0	0	0	**1**
Thelypteris undiff.	1	0	0	0	0	**1**
Filicales undiff.	12	2	0	0	0	**14**
Total	**107**	**105**	**7**	**79**	**5**	**303**
Sphagnum	1	0	0	0	0	**1**
Indeterminate	C4	8	3	11	2	**14**
Lycopodium clavatum						**67**
Carbon frags.						**92**

Table 109 Methvern 516cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	2	0	0	1	4	**7**
Betula	7	2	4	9	0	**22**
Ulmus	3	1	6	9	1	**20**
Salix	3	0	0	0	0	**3**
Coryloid	63	37	12	33	4	**149**
Ericaceae	2	2	1	1	0	**6**
Gramineae	8	9	6	25	2	**50**
Cyperaceae	1	3	0	26	0	**30**
Compositae lig.	2	0	0	0	0	**2**
Polypodium vulgare	1	0	0	0	0	**1**
Filicales undiff.	10	1	0	0	1	**12**
Total	**102**	**55**	**29**	**104**	**12**	**302**
Sphagnum	3	0	0	0	0	**3**
Indeterminate	C2	11	13	11	2	**39**
Lycopodium clavatum						**116**
Pediastrum						**3**
Carbon frags.						**107**

Table 110 Methvern 524cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	6	1	0	1	2	**10**
Betula	6	13	1	11	0	**31**
Ulmus	0	0	1	1	0	**2**
Salix	1	0	0	0	0	**1**
Coryloid	50	52	1	30	2	**135**
Empetrum nigrum	4	2	0	0	0	**6**
Gramineae	12	18	1	49	2	**82**
Cyperaceae	1	1	0	13	0	**15**
Ranunculus type	0	1	0	0	0	**1**
Rosaceae undiff.	1	0	0	0	0	**1**
Rumex acetosa / sella	1	0	0	0	0	**1**
Filicales undiff.	12	1	0	0	3	**16**
Dryopteris undiff.	1	0	0	0	1	**2**
Total	**95**	**89**	**4**	**105**	**10**	**303**
Sphagnum	1	0	0	0	0	**1**
Indeterminate	C4	10	10	17	1	**42**
Lycopodium clavatum						**62**
Carbon frags.						**11**

Table 111 Methvern 532cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	5	3	0	2	2	**12**
Betula	3	3	0	3	0	**9**
Alnus	1	0	0	0	0	**1**
Quercus	1	0	0	0	0	**1**
Ulmus	1	0	0	1	0	**2**
Salix	1	0	0	0	0	**1**
Coryloid	58	32	0	24	1	**115**
Gramineae	11	6	1	22	1	**41**
Cyperaceae	0	2	0	6	0	**8**
Umbelliferae	4	0	0	0	0	**4**
Succisa	1	0	0	0	0	**1**
Compositae tub.	3	0	0	0	0	**3**
Thelypteris undiff.	22	4	0	0	1	**27**
Filicales undiff.	39	33	0	2	3	**77**
Blechnum spicant	1	0	0	0	0	**1**
Total	**151**	**83**	**1**	**60**	**8**	**303**
Indeterminate	C2	6	3	2	0	**13**
Lycopodium clavatum						**71**
Carbon frags.						**113**

Table 112 Methvern 540cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	1	0	4	1	3	**9**
Betula	13	4	5	8	0	**30**
Salix	2	0	0	0	0	**2**
Coryloid	48	33	2	38	0	**121**
Gramineae	5	14	1	55	1	**76**
Cyperaceae	0	0	0	14	0	**14**
Ranunculus type	1	0	0	0	0	**1**
Drosera rotundifolia	1	0	0	0	0	**1**
Compositae lig.	3	0	0	0	0	**3**
Thelpteris undiff.	1	0	0	0	0	**1**
Filicales undiff.	28	6	0	0	5	**39**
Dryopteris undiff.	5	1	0	0	0	**6**
Total	**108**	**58**	**12**	**116**	**9**	**303**
Sphagnum	4	0	0	0	0	**4**
Indeterminate	C2	9	4	7	0	**22**
Lycopodium clavatum						**87**
Carbon frags.						**241**

Table 113 Methvern 548cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	2	1	0	0	4	7
Betula	17	9	4	5	0	**35**
Ulmus	1	1	0	1	1	**4**
Salix	2	0	0	0	0	**2**
Coryloid	62	27	20	46	4	**159**
Ericaceae	0	1	0	0	0	**1**
Gramineae	15	8	1	15	2	**41**
Cyperaceae	0	1	0	11	0	**12**
Rumex acetosa / sella	0	0	0	0	1	**1**
Compositae lig.	1	0	0	0	0	**1**
Thelypteris undiff.	2	0	0	0	0	**2**
Filicales undiff.	20	7	0	0	2	**29**
Dryopteris undiff.	6	0	0	0	0	**6**
Total	**128**	**55**	**25**	**78**	**14**	**300**
Sphagnum	5	0	0	0	0	5
Indeterminate	C1	2	1	6	0	**10**
Lycopodium clavatum						**113**
Carbon frags.						**97**

Table 114 Methvern 556cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	12	2	0	3	5	**22**
Betula	5	9	4	10	0	**28**
Quercus	1	0	0	0	0	**1**
Salix	1	0	0	0	0	**1**
Coryloid	42	110	9	32	1	**194**
Gramineae	4	3	1	10	2	**20**
Cyperaceae	0	0	0	6	0	**6**
Umbelliferae	1	0	0	0	0	**1**
Filicales	19	6	0	0	3	**28**
Dryopteris undiff.	1	0	0	0	0	**1**
Total	**86**	**130**	**14**	**61**	**11**	**302**
Sphagnum	3	0	0	0	0	**3**
Indeterminate	C1	13	5	11	0	**30**
Lycopodium clavatum						**89**
Pediastrum						**1**
Tilletia sphagni						**2**
Carbon frags.						**28**

Table 115 Methvern 564cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	3	0	1	0	3	**7**
Betula	18	7	4	17	1	**47**
Ulmus	0	0	0	1	0	**1**
Salix	6	0	0	0	0	**6**
Coryloid	14	7	2	8	2	**33**
Ericaceae	1	0	0	0	0	**1**
Gramineae	9	6	3	10	1	**29**
Cyperaceae	0	0	0	7	0	**7**
Saxifraga	4	0	0	0	0	**4**
Thelypteris undiff.	2	0	0	0	0	**2**
Filicales undiff.	47	11	2	1	1	**62**
Dryopteris undiff.	2	0	0	0	0	**2**
Total	**106**	**31**	**12**	**44**	**8**	**201**
Sphagnum	1					**1**
Indeterminate	C1	3	2	2	2	**10**
Lycopodium clavatum						**189**
Carbon frags.						**90**

Table 116 Methvern 572cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	3	0	0	0	3	**6**
Betula	6	6	3	2	0	**17**
Salix	5	0	0	0	0	**5**
Coryloid	0	3	0	3	1	**7**
Gramineae	5	32	9	31	2	**79**
Cyperaceae	10	2	1	32	1	**46**
Filipendula	5	0	0	0	0	**5**
Saxifraga stellaris	6	0	0	0	0	**6**
Umbelliferae	1	0	0	0	0	**1**
Filicales undiff.	17	6	0	1	5	**29**
Dryopteris undiff.	3	0	0	0	0	**3**
Total	**61**	**49**	**13**	**69**	**12**	**204**
Indeterminate	0	5	0	4	0	**9**
Lycopodium clavatum						**86**
Pediastrum						**1**
Carbon frags.						**1000**

Table 117 Methvern 580cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	14	1	0	1	12	**28**
Betula	23	20	4	9	8	**64**
Salix	10	0	0	0	0	**10**
Coryloid	7	1	1	1	0	**10**
Gramineae	26	15	1	19	3	**64**
Cyperaceae	1	1	0	26	0	**28**
Saxifraga	1	0	0	0	0	**1**
Thelypteris undiff.	1	0	0	0	0	**1**
Filicales undiff.	61	1	0	0	22	**84**
Dryopteris undiff.	10	0	0	0	0	**10**
Total	**154**	**39**	**6**	**56**	**45**	**300**
Sphagnum	2	0	0	0	0	**2**
Indeterminate	C1	0	3	2	3	**9**
Lycopodium clavatum						**77**
Carbon frags.						**7**

Table 118 Methvern 588cm.

Taxa	Normal	Corroded	Degraded	Crumpled	Split	Total
Pinus	6	0	0	0	1	**7**
Betula	34	21	3	3	1	**62**
Salix	1	0	0	1	0	**2**
Empetraceae	1	0	0	0	0	**1**
Gramineae	38	49	0	55	6	**148**
Cyperaceae	6	7	0	30	0	**43**
Filipendula	2	0	0	0	0	**2**
Saxifraga	2	0	0	0	0	**2**
Drosera rotundifolia	3	0	0	0	0	**3**
Filicales undiff.	16	1	0	1	8	**26**
Dryopteris undiff.	7	0	0	0	3	**10**
Total	**116**	**6**	**3**	**90**	**19**	**306**
Sphagnum	2	0	0	0	0	**2**
Menyanthes trifoliata	1	0	0	0	0	**1**
Indeterminate	C1	4	4	1	1	**11**
Lycopodium clavatum						**105**
Carbon frags.						**11**

Table 119 Methvern 596cm.

Taxa	Normal	Corroded	Degraded	Crumpled	Split	Total
Pinus	3	0	0	0	3	**6**
Betula	42	15	1	1	0	**59**
Salix	7	0	0	0	0	**7**
Empetraceae	2	0	0	0	0	**2**
Gramineae	31	45	1	49	9	**135**
Cyperaceae	8	2	0	42	2	**54**
Rosaceae undiff.	2	0	0	0	0	**2**
Filipendula	6	0	0	0	0	**6**
Dryas	1	0	0	0	0	**1**
Saxifraga	5	0	0	0	0	**5**
Umbelliferae	1	0	0	0	0	**1**
Filicales undiff.	8	1	0	0	15	**24**
Total	**116**	**63**	**2**	**92**	**29**	**302**
Menyanthes triofliata	2	0	0	0	0	**2**
Indeterminate	C3	5	0	3	1	**12**
Lycopodium clavatum						**56**
Pediastrum						**1**
Carbon frags.						**7**

Table 120 Methvern 608cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	2	0	0	1	3	**6**
Betula	46	25	0	1	6	**78**
Alnus	2	0	0	0	0	**2**
Salix	3	0	0	0	0	**3**
Coryloid	1	0	0	0	1	**2**
Empetraceae	2	0	0	0	0	**2**
Gramineae	18	23	5	23	8	**77**
Cyperaceae	4	2	3	28	1	**38**
Filipendula	3	0	0	0	0	**3**
Geum rivale	1	0	0	0	0	**1**
Saxifraga	9	0	0	0	0	**9**
Narthecium ossifragum	6	0	0	0	0	**6**
Filicales undiff.	22	3	0	0	23	**48**
Dryopteris undiff.	32	0	0	0	10	**42**
Total	**151**	**53**	**8**	**53**	**52**	**317**
Sphagnum	1	0	0	0	0	**1**
Indeterminate	0	6	3	3	3	**15**
Lycopodium clavatum						**77**
Pediastrum						**2**
Carbon frags.						**7**

Table 121 Methvern 624cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	0	0	0	0	2	**2**
Betula	53	1	0	1	1	**56**
Salix	15	0	0	0	0	**15**
Coryloid	2	0	0	0	0	**2**
Empetraceae	21	0	0	0	0	**21**
Gramineae	63	34	0	35	9	**144**
Cyperaceae	0	0	0	11	0	**11**
Hypericum pulchrum	1	0	0	0	0	**1**
Caryophyllaceae	3	0	0	0	0	**3**
Filipendula	5	0	0	0	0	**5**
Geum rivale	1	0	0	0	0	**1**
Sedum type	2	0	0	0	0	**2**
Sedum rosea	1	0	0	0	0	**1**
Saxifraga	19	0	0	0	0	**19**
Umbelliferae	2	0	0	0	0	**2**
Compositae lig.	1	0	0	0	0	**1**
Adoxa moschatellina	2	0	0	0	0	**2**
Artemisia	1	0	0	0	0	**1**
Filicales	4	0	0	0	0	**4**
Dryopteris undiff.	9	0	0	0	0	**9**
Total	**205**	**35**	**0**	**47**	**12**	**302**
Menyanthes trifoliata	32	0	0	0	0	**32**
Indeterminate	C2	0	1	0	0	**3**
Lycopodium clavatum						**65**
Pediastrum						**33**
Carbon frags.						**3**

Table 122 Methvern 640cm.						
Taxa	**Normal**	**Corroded**	**Degraded**	**Crumpled**	**Split**	**Total**
Pinus	2	1	0	1	5	**9**
Betula	4	0	0	0	0	**4**
Salix	1	0	0	0	0	**1**
Gramineae	14	35	0	45	3	**97**
Cyperaceae	1	0	0	20	0	**21**
Thalictrum alpina	1	0	0	0	0	**1**
Ranunculus type	1	0	0	0	0	**1**
Caryophyllaceae	4	0	0	0	0	**4**
Chenopodiaceae	2	0	0	0	0	**2**
Saxifraga	1	0	0	0	0	**1**
Koenigia islandica	1	0	0	0	0	**1**
Compositae tub.	2	0	0	0	0	**2**
Artemisia	1	0	0	0	0	**1**
Lycopodium selago	2	0	0	0	0	**2**
Selaginella selaginoides	4	0	0	0	0	**4**
Filicales undiff.	3	0	0	0	0	**3**
Total	**44**	**36**	**0**	**66**	**8**	**154**
Sphagnum	1	0	0	0	0	**1**
Indeterminate	0	2	0	2	1	**5**
Lycopodium clavatum						**309**
Pediastrum						**2**
Carbon frags.						**10**